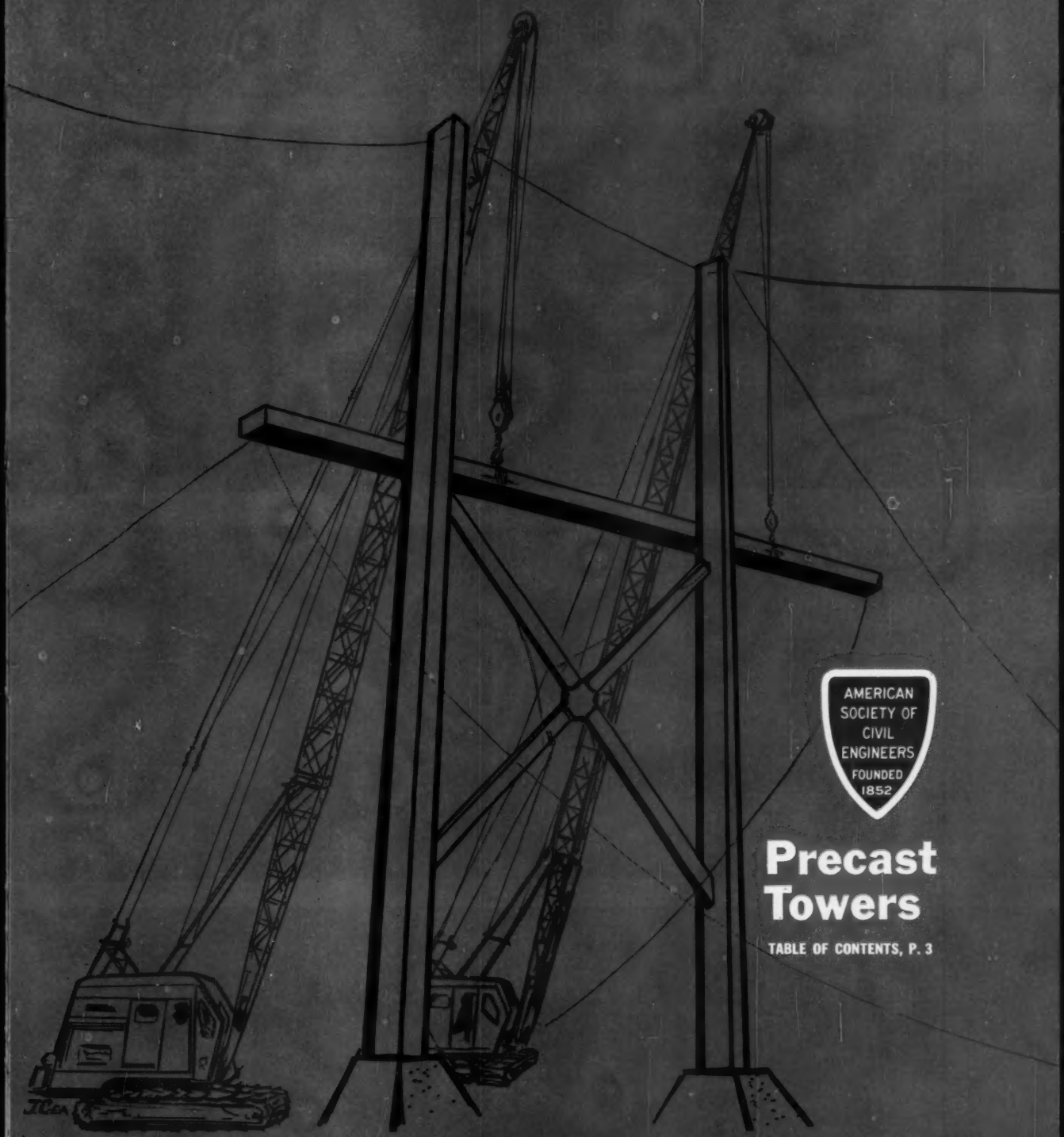
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • AUGUST 1961



AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Precast Towers

TABLE OF CONTENTS, P. 3

ANNUAL CONVENTION • NEW YORK • OCT. 16-20

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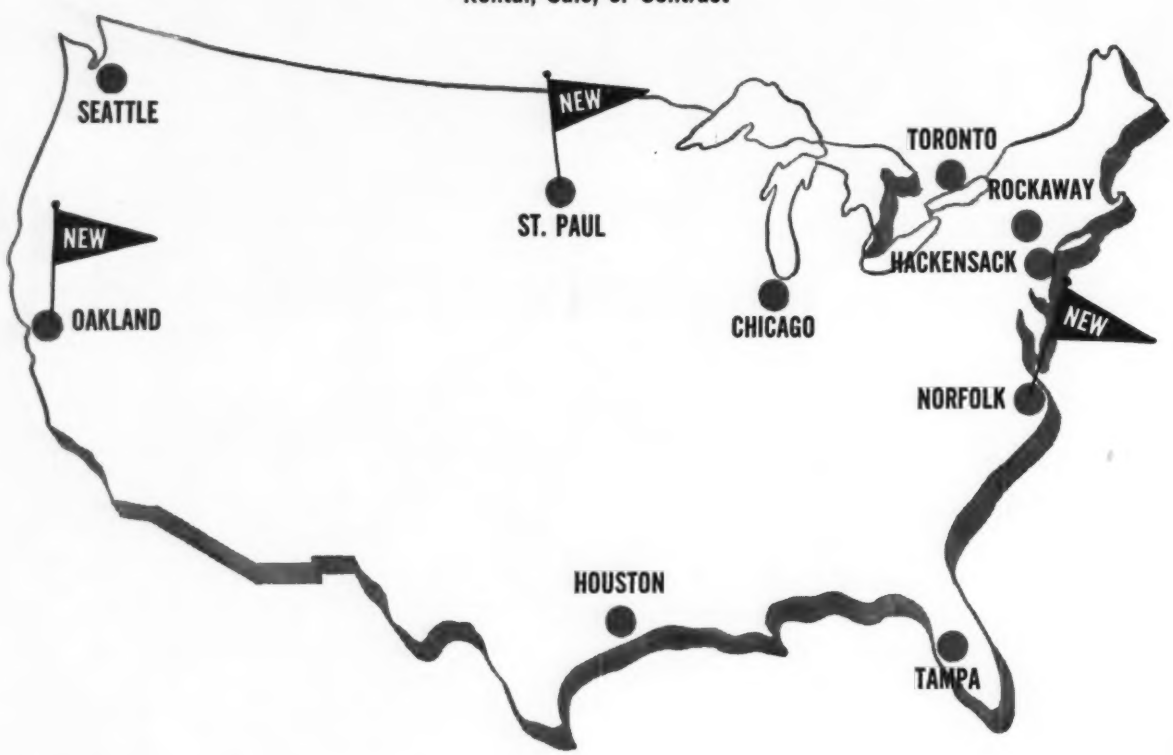

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P.O. Box 7581 Norfolk 15, Virginia NOrfolk 487-0551	4765 North Highway #8 St. Paul 12, Minnesota MElrose 3-6393	7701 Interbay Blvd. Tampa 9, Florida TAmpa 61-1871	**WESTERN REPRESENTATIVE:** Pacific Pumping Company 9201 San Leandro St. Oakland 4, California	**BRAZILIAN REPRESENTATIVE:** Oscar Taves & Co., Ltd. Rio de Janeiro

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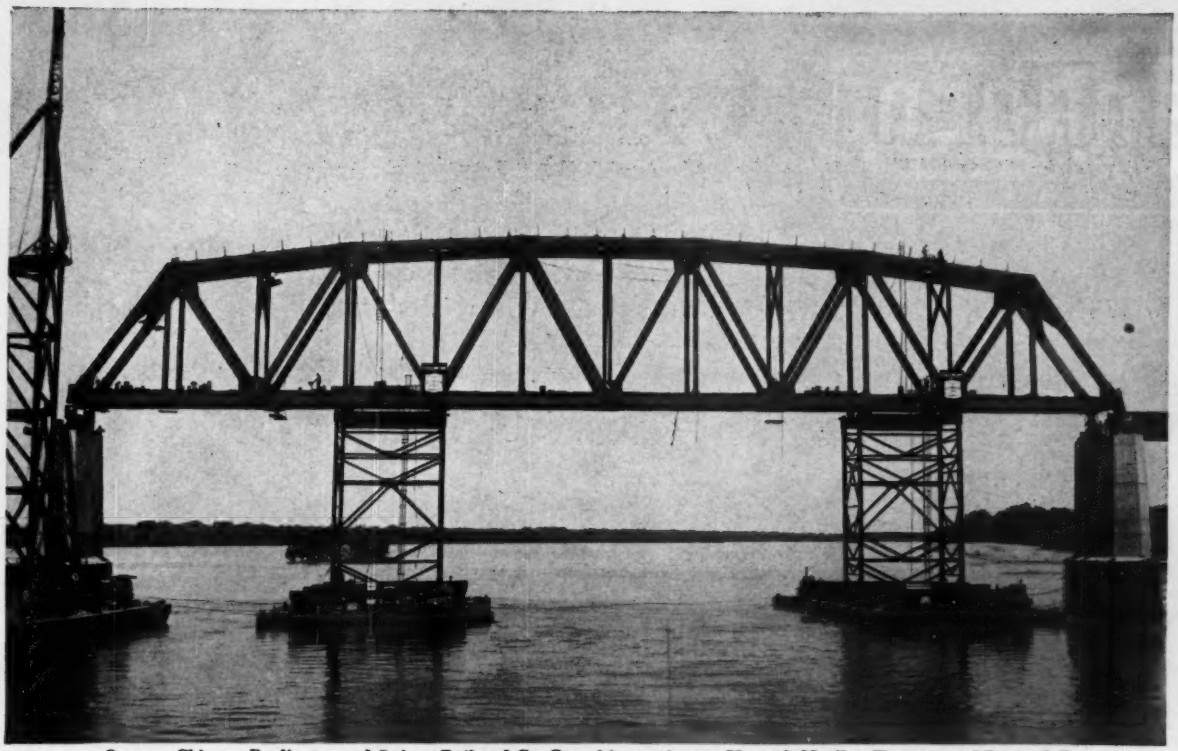
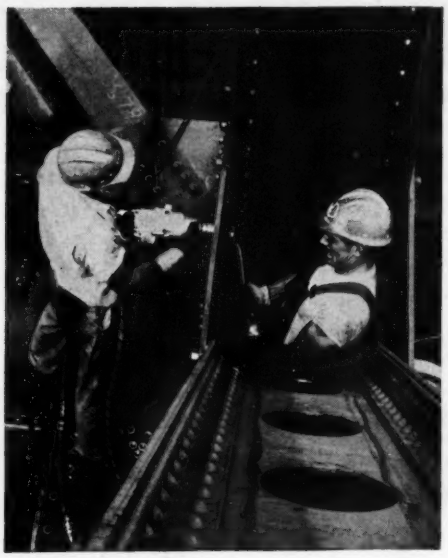


Owners: Chicago, Burlington and Quincy Railroad Co. Consulting engineers: Howard, Needles, Tammen and Bergendoff

Longest railroad bridge to be high-strength bolted



The entire 4½-mile-long, CB&Q Railroad crossing, bridging the Mississippi near Quincy, Illinois, was designed for field riveting. But unusually high flooding and difficulty in locating experienced riveting crews caused delays in completing the 336-ft through-truss span, shown above. To speed up the job, Bethlehem requested the approval of the CB&Q to bolt the remaining two-thirds of the crossing, requiring 140,000 high-strength bolts.

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AUGUST 1961
VOL. 31 • NO. 8

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• ARTICLES

C. F. Wicker, Chairman — 33 — **Projects for hydraulic research—a committee report**

Max Ford — 37 — **Flaming Gorge Dam**

Morris Schupack, Alex McDonald — 46 — **Experimental transmission tower of precast, prestressed concrete**

J. S. Marcus — 48 — **Uses of radioisotopes in civil engineering**

Frederick Willsea — 51 — **Offshore oil-well drilling structures**

Vernon A. Smoots, Philip H. Benton — 54 — **Compacted earth fill for a power-plant foundation in California**

Carl C. Winikka — 58 — **Distance measurement by Geodimeter and Tellurometer**

G. E. Weatherford — 62 — **A new shape for a storage structure**

Thomas W. Mitcham — 64 — **Tunnel-site selection by aerial photography**

• ASCE NEWS

42 **Present ASCE Headquarters built on stilts**

44 **Need for water research shown at Fort Collins Symposium**

45 **Tellers canvass ballot for 1962 officers**

68 **Cities in the year 1980—Annual Convention theme**

70 **Engineers' role in world affairs stressed at ASEE meeting**

70 **ASCE Overseas Unit formed in France**

71 **Amended Code of Ethics ratified by members**

71 **ASCE prizes and awards announced by Board**

72 **Papers invited for Applied Mechanics Congress**

74 **Notes from the Local Sections**

78 **The Younger Viewpoint**

80 **By-line Washington**

• DEPARTMENTS

18 News of Members
29 Am-Soc Briefs
31 Do You Know That
64 Engineers' Notebook
65 The Readers Write
71 Salary Index of ASCE
72 Scheduled ASCE Meetings
86 News Briefs
92 Exam Gems
98 Deceased
102 Non-ASCE Meetings
103 Applications for Membership
104 Recent Books
106 Men and Jobs Available
108 Equipment, Materials, and Methods
115 Literature Available
118 Films Available
119 From the Manufacturers
126 Index to Advertisers

120 PROCEEDINGS papers available

Rolling Mill redesigned with A36 Structural Steel Saved: 44 tons

This mark tells you a product is made of modern, dependable Steel.

The new rolling mill building for Border Steel Rolling Mill, Inc., El Paso, Texas, is 800 feet long, 142 feet wide and 50 feet high. Design, steel fabrication and erection by Ramsey Steel Company, Inc., El Paso, Texas. Mr. W. K. Ramsey, President (left) and Mr. G. W. Ramsey, Chief Engineer.

"We redesigned the rolling mill building for Border Steel Rolling Mill, Inc., to take advantage of the higher strength of A36 Steel. Our original plans were made before the introduction of A36 Steel," said Mr. W. K. Ramsey, president of Ramsey Steel Company, Inc., "and called for 794 tons of A7 Steel. By redesigning with A36 we cut the cost of structural steel almost 10%. In columns and beams alone we saved 44 tons of steel. A36 Steel also saved us $6.00 a ton on shipping charges. At that time, A36 wasn't available in all shapes or we could have saved even more by making the roof trusses of A36 Steel, too."

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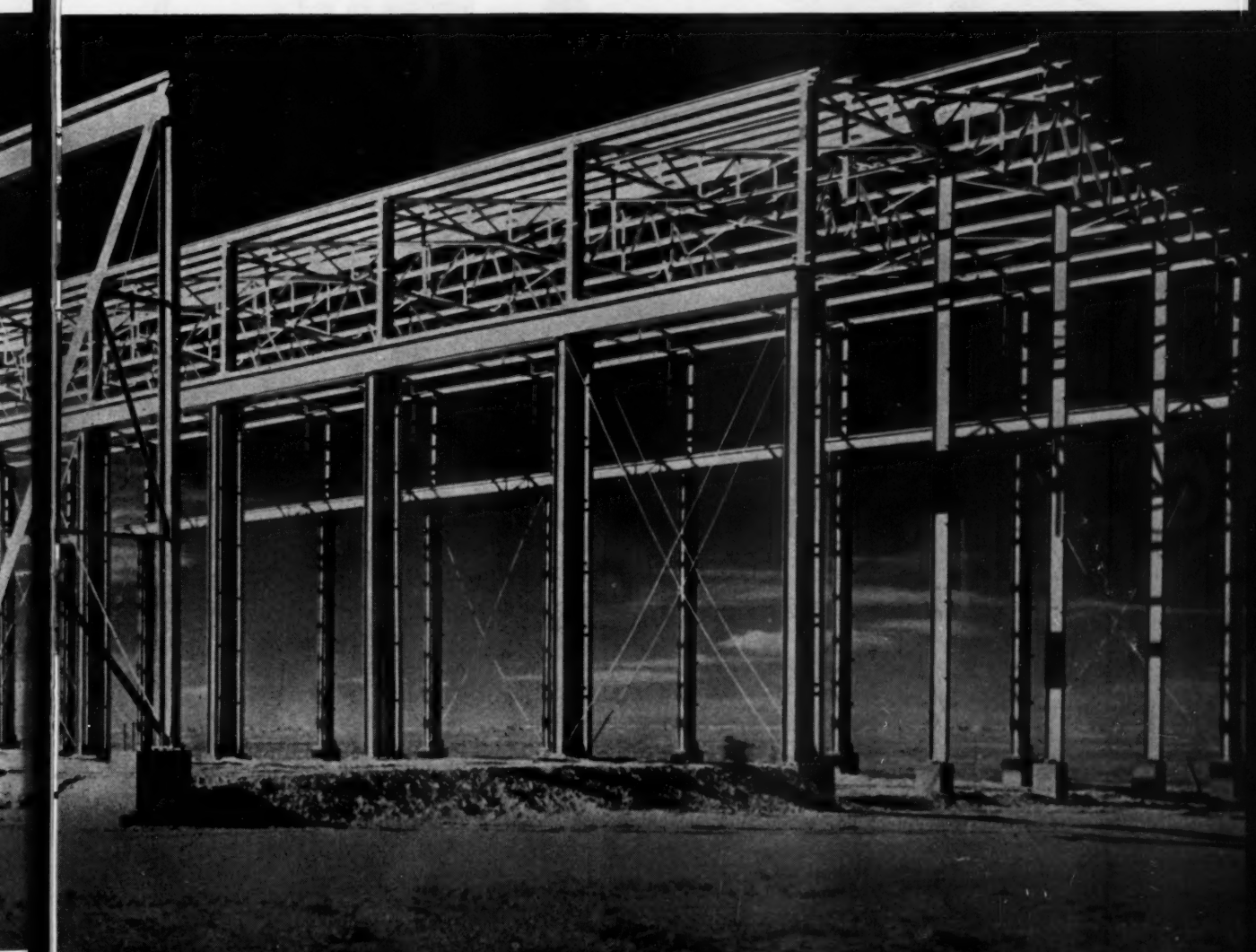
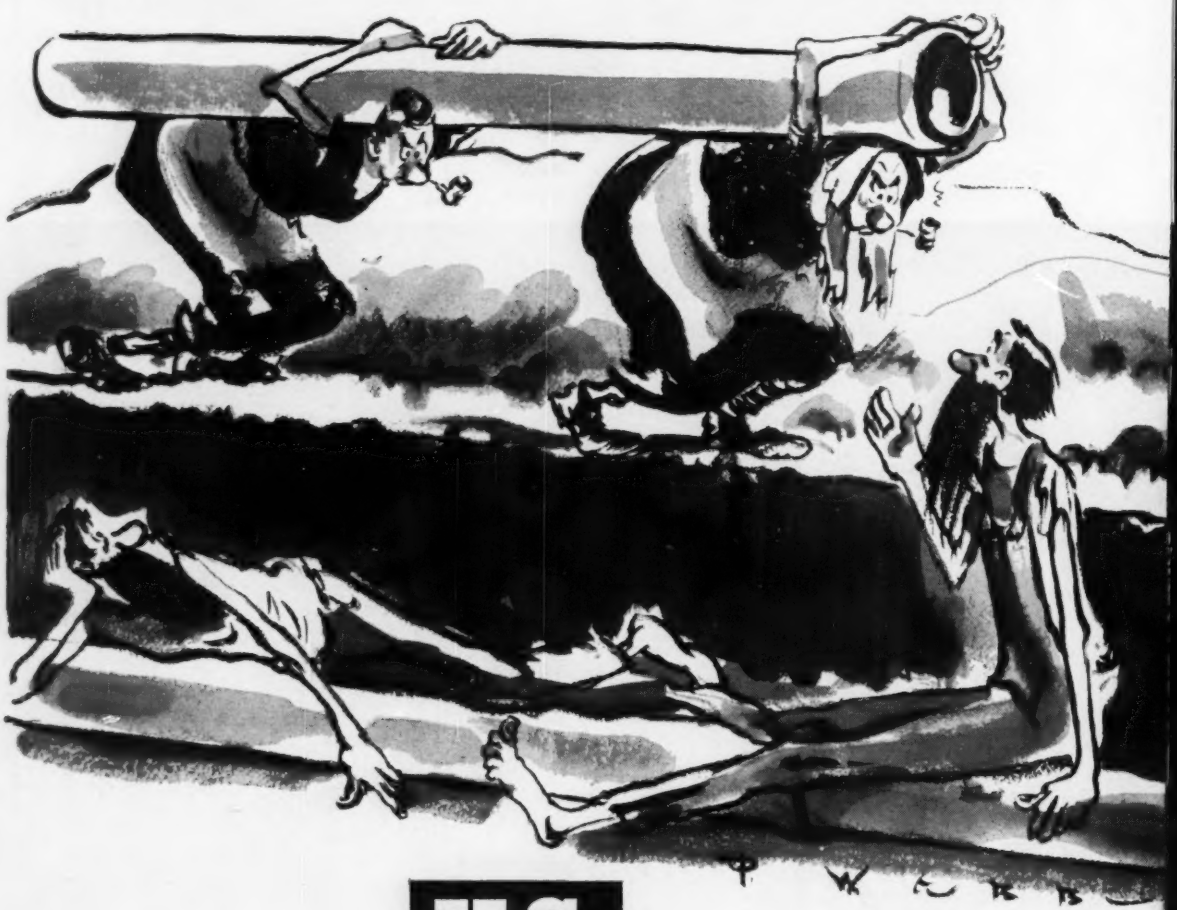


"Could you fetch it
a little quicker Gran'maw
Tyton lays mighty fast y' know"



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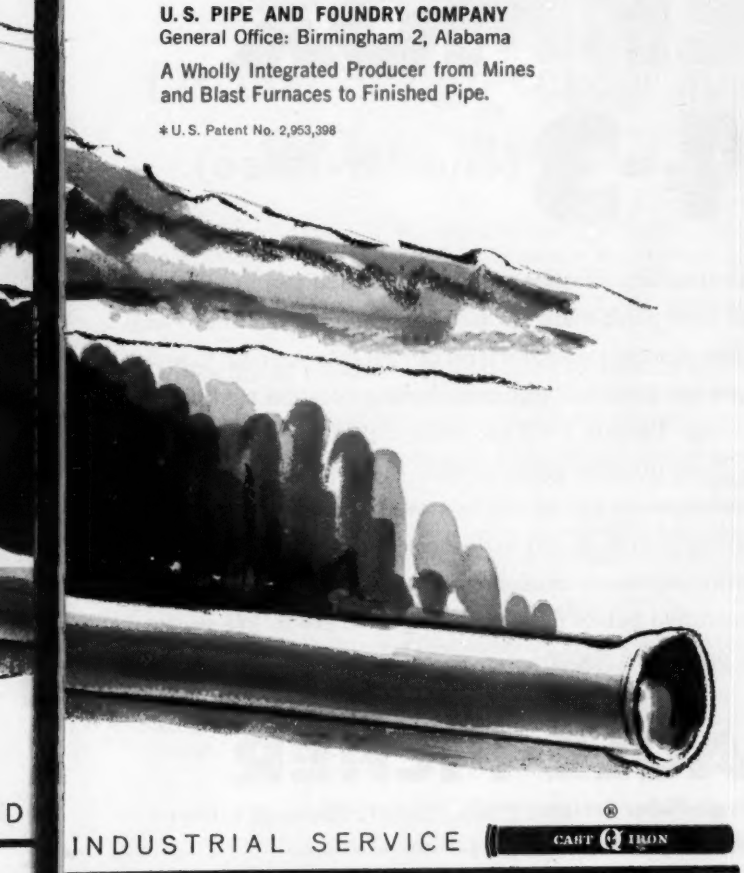

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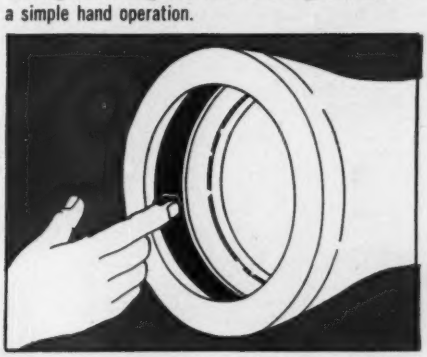
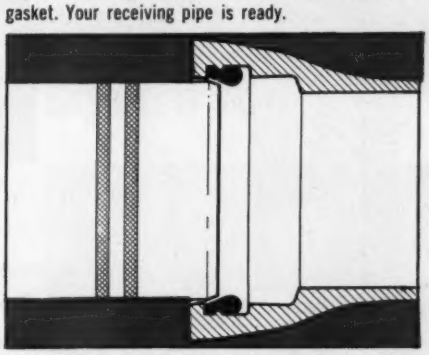
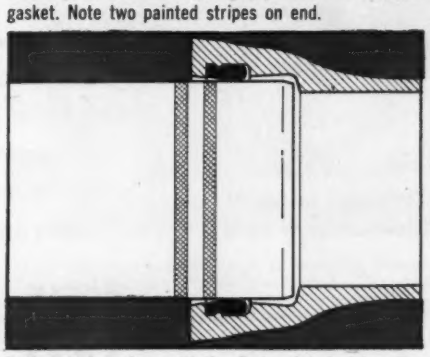


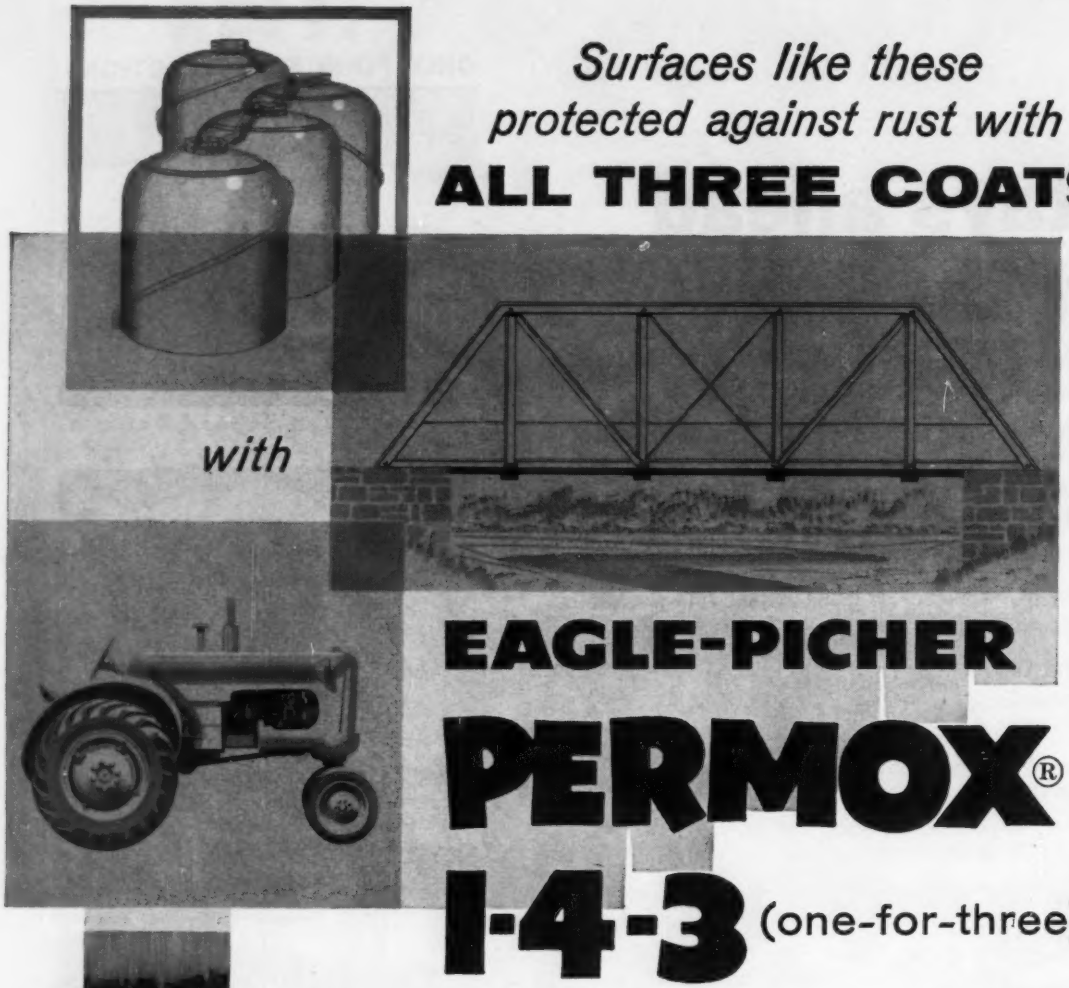
Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?



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City maintenance forces were quick to see two major advantages of Cationic Bitumuls when it was first introduced. A—This material had a natural affinity for the cover aggregate being used. B—The rapid-setting characteristics sharply reduced the danger of "wash-off" from rain. (When showers actually occurred within two hours of job completion, there was no damage!)

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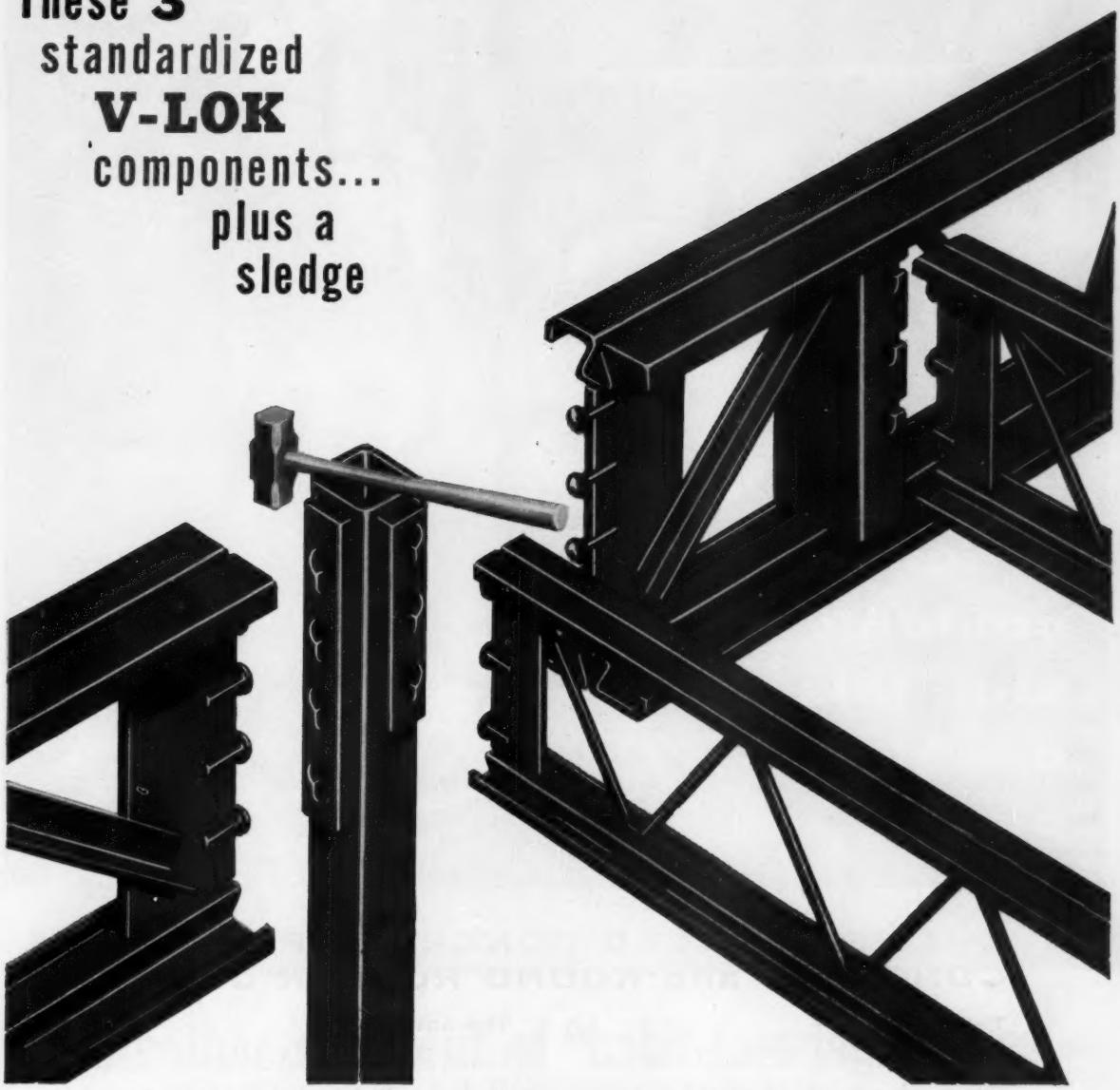

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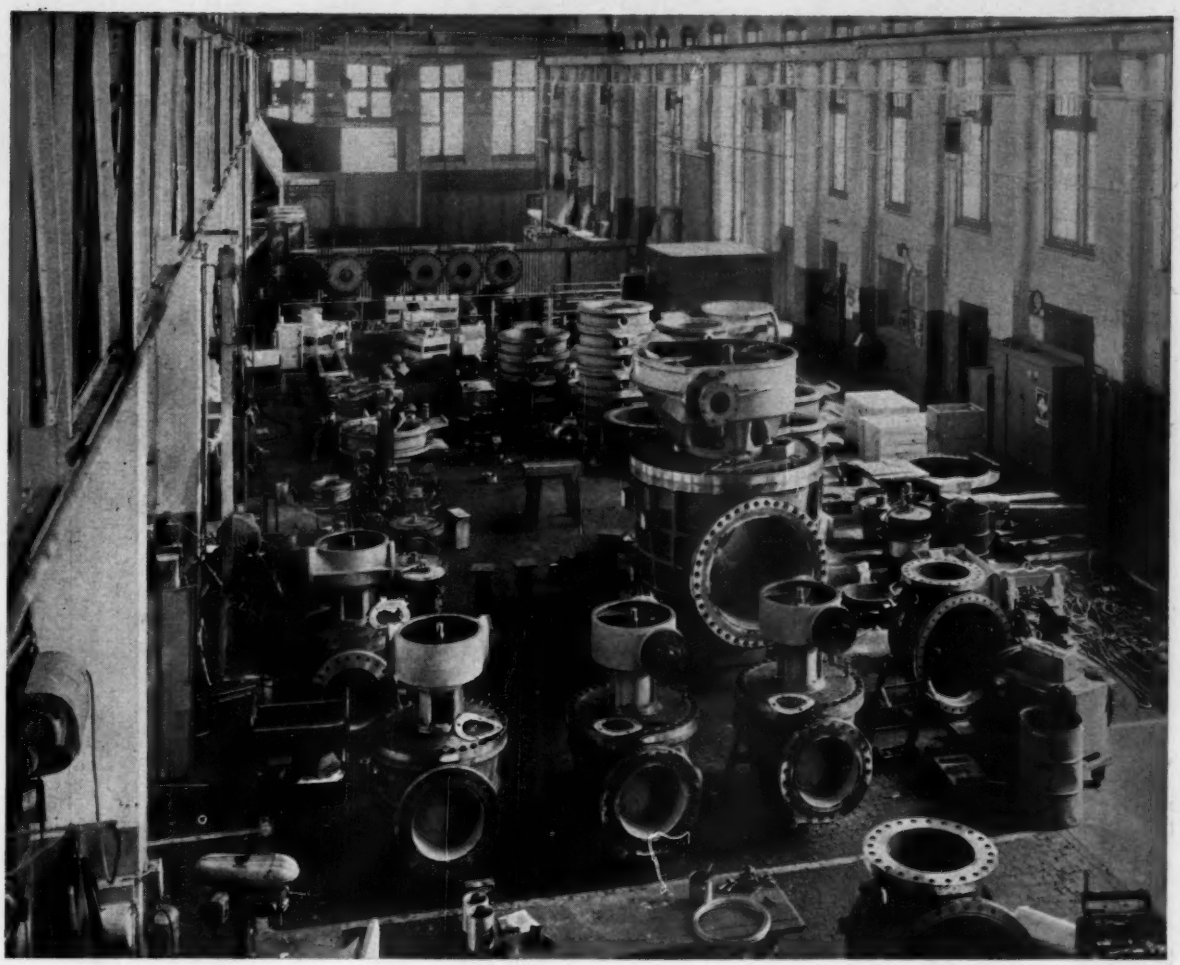

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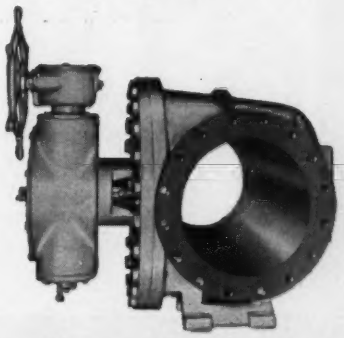

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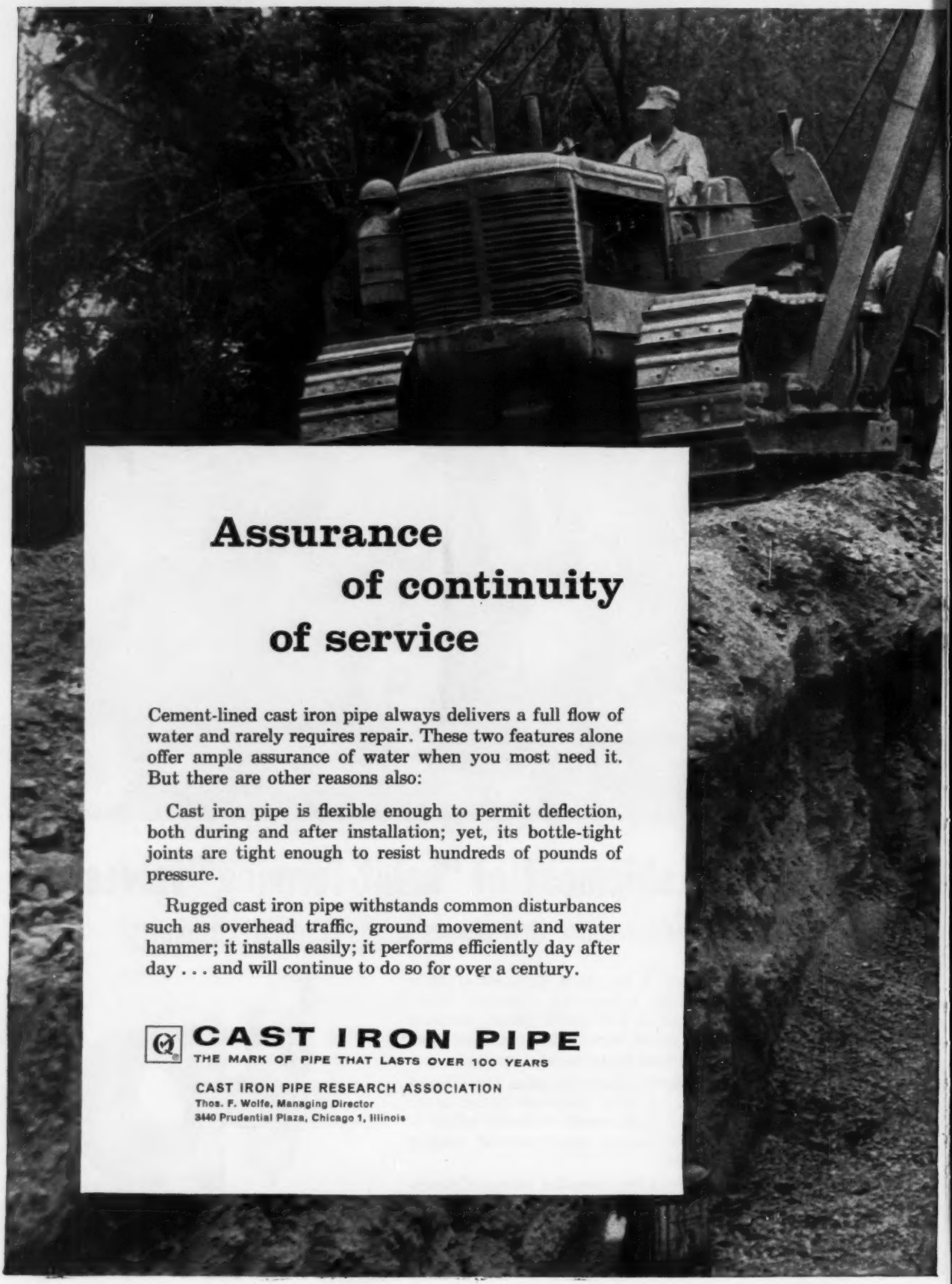

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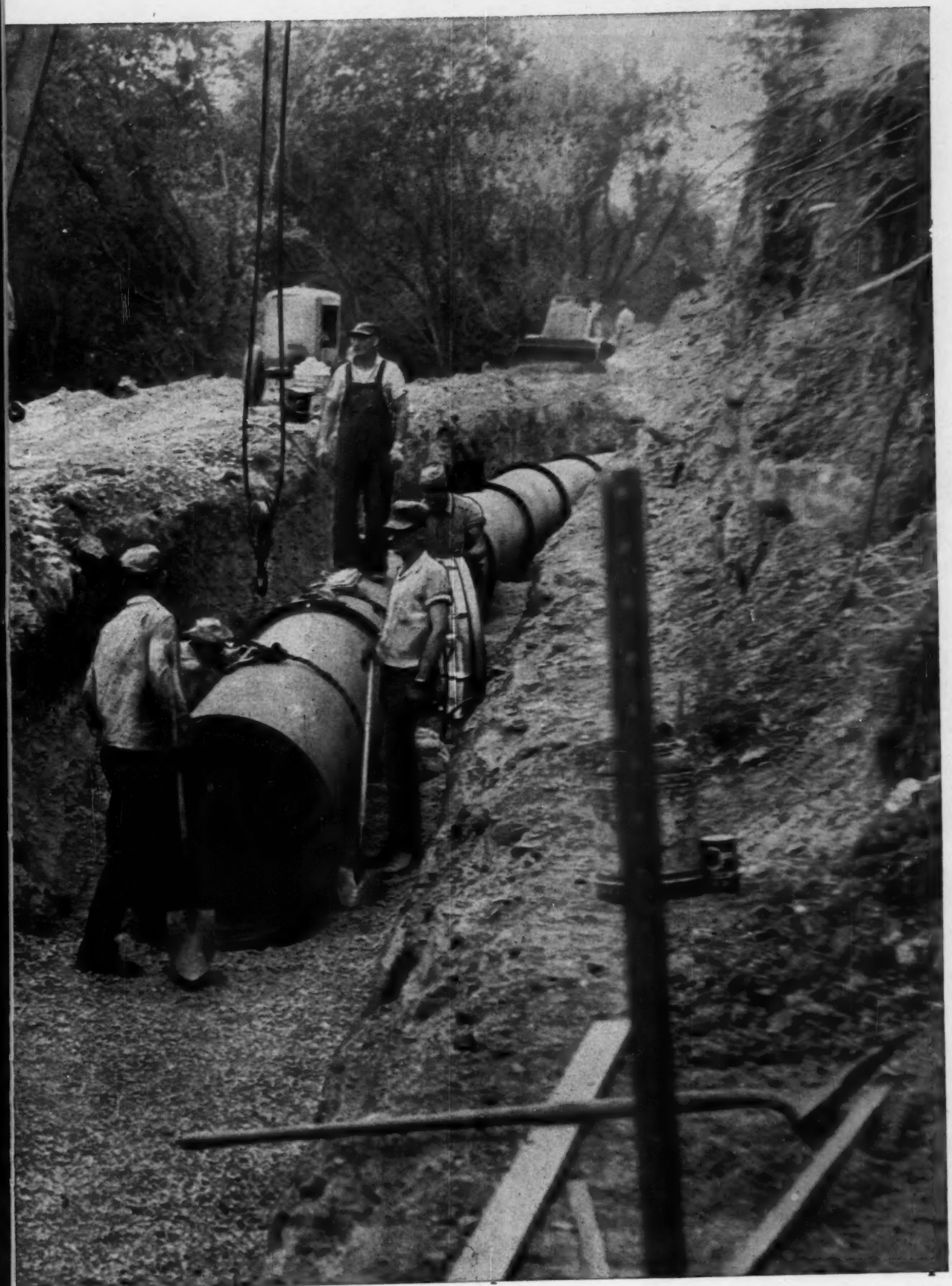

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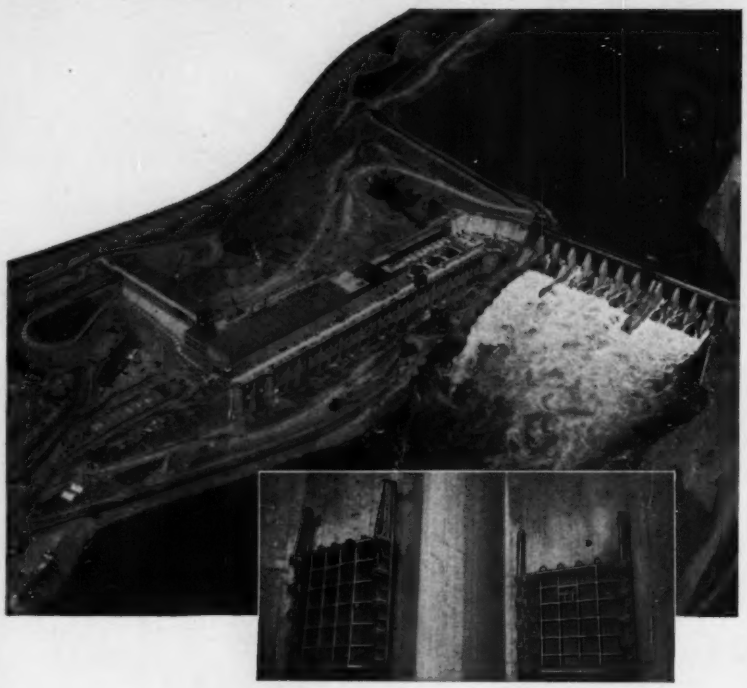
A STEPLADDER FOR SALMON WITH 127 RODNEY HUNT HY-Q® SLUICE GATES



Rocky Reach Hydro-Electric Project Solves Migration Problem

When dams are constructed in such fish-rich streams as the Columbia River, a major part of the construction can involve the provision of a means for passage of the fish. This has been true of the soon-to-be-completed Rocky Reach Hydro-Electric Project in Wenatchee, Washington. The looping fishway built to solve this problem can be seen at the left in the aerial photograph taken while the project was under construction.

A total of 127 Rodney Hunt cast-iron, bronze-mounted HY-Q Sluice Gates are installed as part of this fishway system. Upstream of the center dam fishway entrance are located 76 gates, each 48″ x 27″. These gates will be regulated to furnish attraction water in the fishway diffusion chambers. This water is discharged at the fishway entrance to attract the salmon on their migration upstream. In other areas of the system there are 49 Rodney Hunt gates, each 42″x27″. Two 78″ x 78″ motor-operated gates are shown in the smaller photograph above prior to installation of operating stems. The gates are located downstream of the traveling water screens in the pump intake structure and at the end of the intake pipe leading to the three fishway turbine pumps in the service way. An additional Rodney Hunt gate, 78″ x 78″, is also installed at the spillway of the dam.

The Rocky Reach Hydro-Electric Project for Chelan County Public Utility District No. 1 was designed and construction supervised by Stone & Webster Engineering Corporation, Agents for the District. Rocky Reach Contractors, a joint venture of L. E. Dixon Company, American Pipe and Construction Company, The Arundel Corporation, Guy F. Atkinson Company and Hunkin-Conkey Construction Company, were the General Contractors and installed the Rodney Hunt sluice gates. Tullar Power Construction, Inc. & Associates were the electrical contractors.

• •

More Than Just A Catalog!

We call it our Sluice Gates Catalog, but it's really a lot more than that. Some people have called it the bible of the industry. However, we do say that it is a book that everyone concerned with water control and sewage treatment will find to be of permanent value.

Since it is a catalog, it naturally offers full details of all the gates, hoists and auxiliary equipment manufactured by Rodney Hunt. But there are a great many other things in it. For example, there is a section detailing the proper installation of sluice gates. And in the back of the book are more than 20 pages of engineering data, including instructions and formulae for determining the size of sluice gates, the flow of water in pipes, in streams and in open channels, as well as many helpful tables. To obtain a copy, write us on your letterhead.

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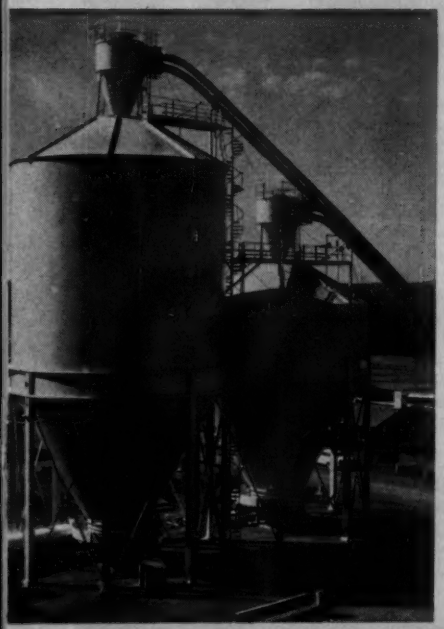

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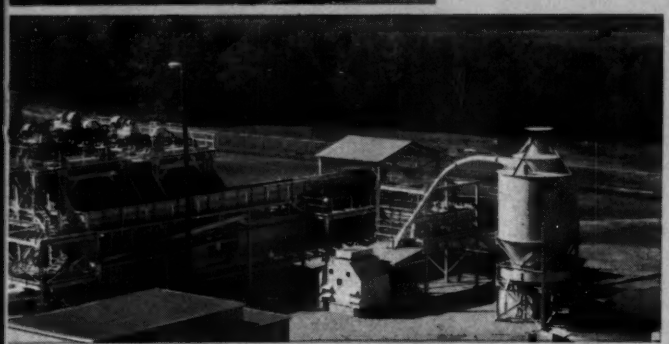
DALLAS (1).....Suite 1703, Southland Center
DENVER (2).....323 Railway Exchange Bldg.
SEATTLE (1).....500 Wall Street



37 Steel Tanks and Bins for Tennessee River Pulp and Paper Co. at Counce, Tenn.

NEWS OF MEMBERS

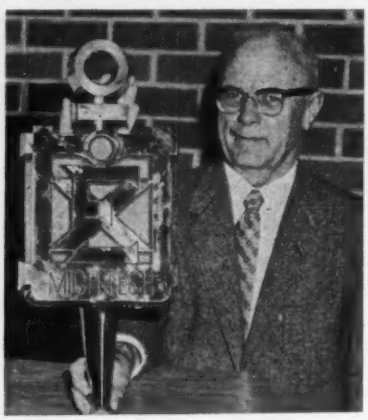
Basil W. Wilson, until recently professor of engineering oceanography at Texas Agricultural and Mechanical College, is now a member of the Senior Staff at the National Engineering Science Company, in Pasadena, Calif. A second recent addition to the staff is the former chief of the Oceanographic Branch in the Research Division of the Beach Erosion Board of the Corps of Engineers, **Charles L. Bretschneider.** Dr. Bretschneider will be in charge of NESCO's recently established office in Washington, D.C.

John W. Towers is now associated with the Syosset, N.Y., firm of Lockwood, Kessler & Bartlett, Inc., as chief civil and sanitary engineer. He previously served in a similar capacity with United Engineers, Inc., of Boston, Mass.

Othmar H. Ammann, of the firm of Ammann & Whitney, recently received the 1961 Award of Merit of the New York Chapter of the American Institute of Architects "for creating structures of outstanding beauty and engineering significance" — represented by the George Washington Bridge, Triborough Bridge, Bronx-Whitestone Bridge, Throgs Neck Bridge and the Narrows Bridge—and "for inspiring the engineers and architects with whom he worked." Mr. Ammann is an Honorary Member of ASCE.

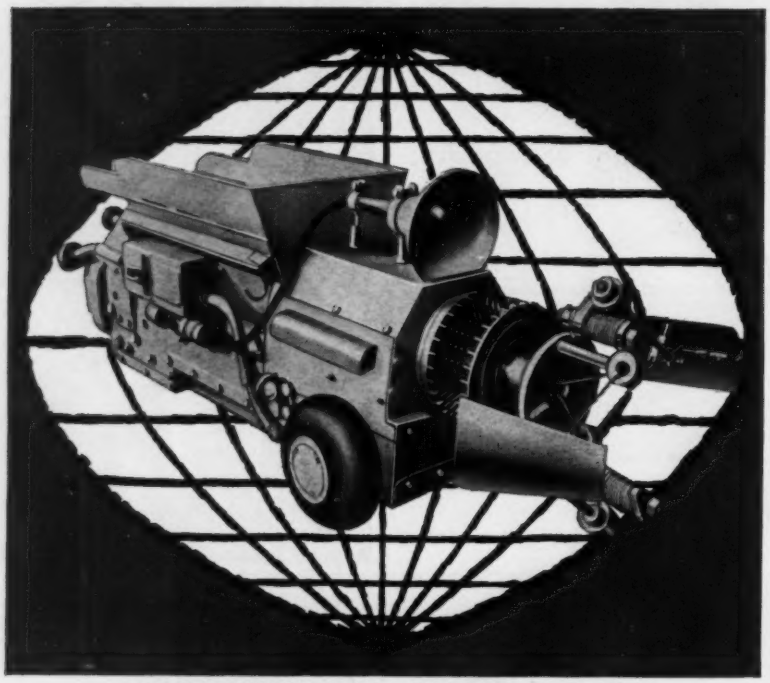
Jerome O. Ackerman, widely known in river development circles in the mid-west, having served for the last 12 years as chief of the Engineering Division of the Corps of Engineers Omaha District Office, is now chief of the engineering staff of the Missouri River Division Engineer. His service in the Corps spans nearly 33 years, and includes supervision of planning and design of major dams on the Missouri River in South Dakota.

William E. Korbitz, who has been city engineer for three Michigan municipalties—Cadillac in 1954 and 1955, Big Rapids from 1955 to 1957, and Niles since March of 1957—is now city engineer for Boulder, Colo.



The Chi Epsilon Student Chapter at the Michigan College of Mining and Technology, recently honored Wilfrid C. Polkinghorne, long-time professor and head of the civil engineering department there on the occasion of his retirement after 40 years of service. In addition to receiving a large "transit" (shown here), a plaque honoring Professor Polkinghorne and another Michigan Tech professor, Gerald Caspary, will be placed in the lobby of the Civil Geology Auditorium.

(Continued on page 20)



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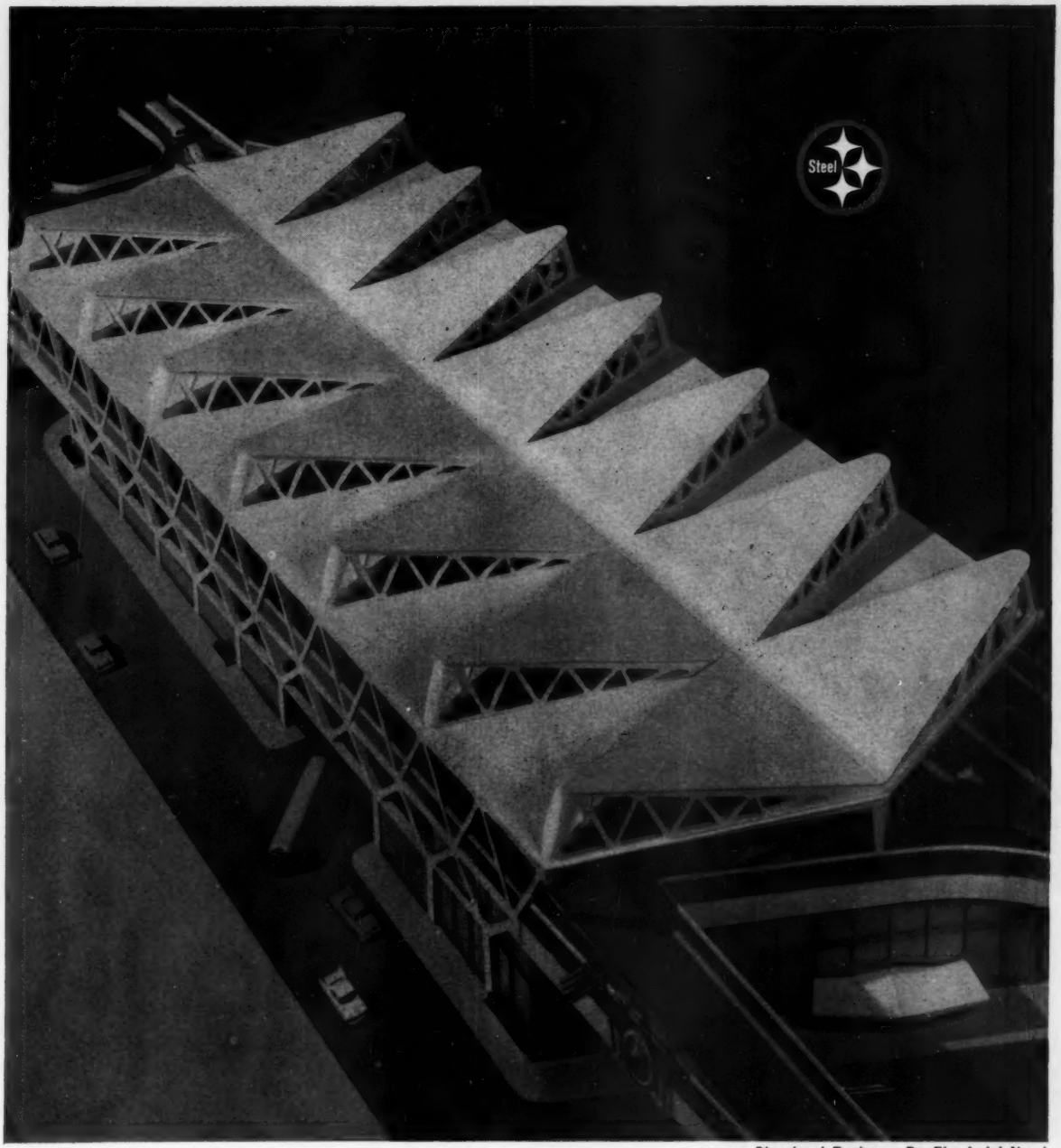

Structural Engineer: Dr. Pier Luigi Nervi

NELSON COMPOSITE BEAMS . . . MUSCLES FOR BUS TERMINAL

This is a model of the two-block-long, three-level George Washington Bridge bus terminal, New York City. Esthetic architectural design provides a "built-in" feeling of movement. Composite Design provides a "built-in" certainty of strength. Composite Design is the "tying" or "bonding" of concrete floor slabs to steel beams by welding Nelson Stud Shear Connectors to the top flanges. When the concrete sets, the three elements act as a unit. This unit is called the Nelson Composite Beam. This design technique helps meet load requirements with shallower, less costly steel beams (or increases strength with the same size beams). It provides longer spans with greater load-carrying capacity per pound of steel. More unobstructed floor space through wider spacing of columns. For information about Composite Building Construction, write to **NELSON STUD WELDING,** Division of Gregory Industries, Inc., Dept. 14, Lorain, Ohio.

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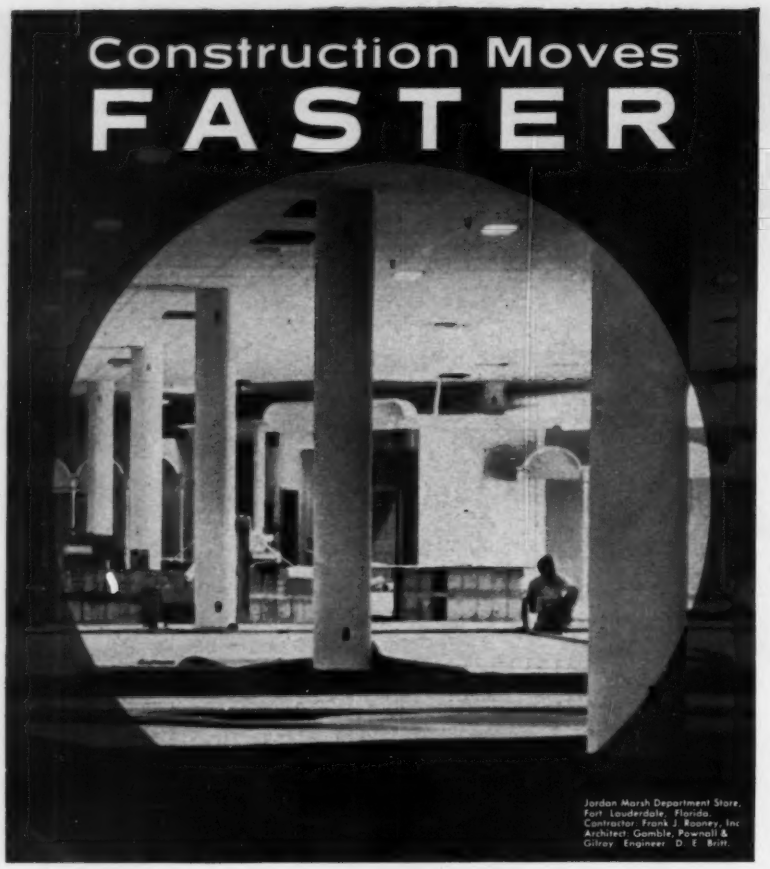
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Robert B. Diemer, after 32 years of service with the Los Angeles (Calif.) Metropolitan Water District, the last ten as general manager and chief engineer, will retire in the early fall. Recognized as one of the nation's leading waterworks experts, he reached retirement age two years ago but remained at his job under special arrangements to supervise completion of the Water District's $220 million expansion program, initiated by him in 1952. Mr. Diemer over the years has been instrumental in the surveying, designing and construction of the Colorado River Aqueduct, now delivering water to 7.5 million people in 93 cities.

Ralph A. Easley, Jr., after four years of active duty as an officer in the Civil Engineer Corps of the U.S. Navy, has been named director of Public Works and city engineer for the City of Ojai, Calif.

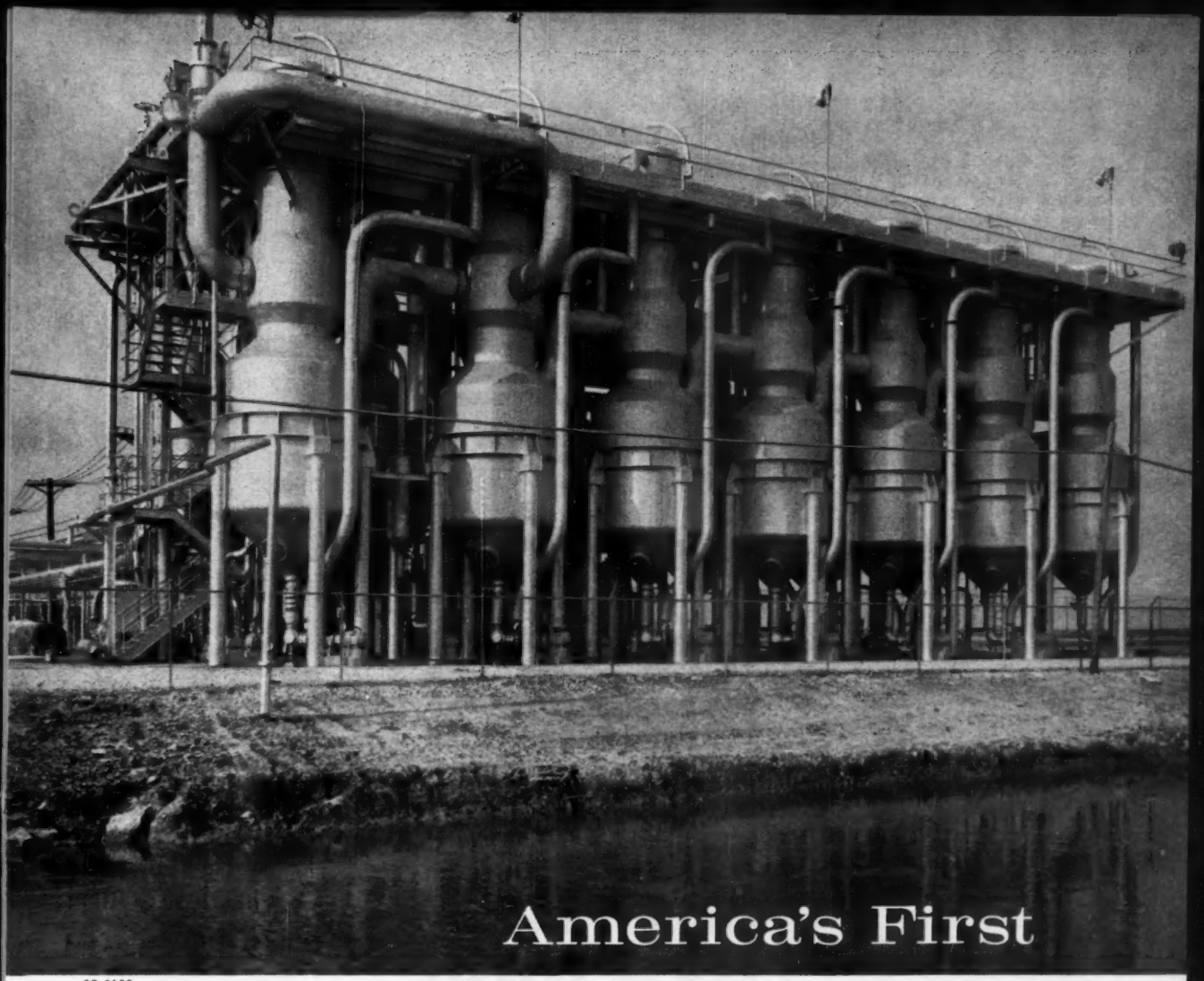
Robert M. Holcomb, professor at the Texas Agricultural and Mechanical College, has been appointed dean of the SEATO Graduate School of Engineering in Bangkok, Thailand, to succeed **T. H. Evans,** who has returned to Colorado State University where he is dean of engineering. **Robert B. Banks,** who recently arrived in Bangkok to begin an assignment as director of research at the SEATO Graduate School, is on leave-of-absence from Northwestern University where he was assistant dean for research and graduate studies and professor of engineering science. He replaces **Marion R. Carstens,** of the Georgia Institute of Technology, while **Norbert L. Ackermann,** assistant professor at the University of Khartoum, Sudan (under the Northwestern University Exchange Program) has been appointed assistant professor at the SEATO School. All appointments are for two years.

Sidney Freedman, as part of his new duties as research engineer, will conduct research studies at the National Concrete Masonry Association Laboratory in Washington, D.C., as well as coordinate research programs jointly sponsored by the Association and other organizations in the construction industry. His last position was as field engineer in the Washington-Baltimore area for the Zonolite Company.

William A. Alexander, chief engineer and manager of the Lower Tule River Irrigation District since 1950 and of the Pixley Irrigation District since 1958, subject to State Senate confirmation, has been appointed to succeed **W. P. Rowe** on the California State Water Rights Board for a four-year term. Mr. Rowe recently retired after serving on the board since 1956.

Robert F. Balcerzak, Orleans (N.Y.) County's new civil defense director, will continue as chief engineer and a member of the general contracting firm of Frank J. Balcerzak & Son in Medina, N.Y. As the present chief of the radiological section of the Orleans Civil Defense Department, he is conducting a five-week radiological school for about 30 area men.

(Continued on page 23)



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Built by CB&I for the Office of Saline Water, U. S. Dept. of Interior, it is capable of producing 1,000,000 gallons of fresh water daily from the salty Gulf of Mexico at Freeport, Texas. The facility is expected to produce this volume for less than $1 per thousand gallons.

Valuable operating information, including methods of combating corrosion and scale formation, will be provided for future and larger installations to follow.

CB&I completed the design, fabrication and erection of the steel structure in less than a year. This included an 8-day test run.

To learn how CB&I's extensive experience with process design, fabrication and erection in many fields can be advantageously applied to your plant problems, write to Chicago Bridge & Iron Company, 332 South Michigan Avenue, Chicago 4, Illinois. Offices and subsidiaries are located throughout the world.

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STEEL CONSTRUCTION IN AN 8-STORY APARTMENT BUILDING? YES AND IT SAVED $80,000

For the builders of new Hinman House in Evanston, Illinois, steel offered exceptional flexibility of design and a direct saving of $80,000 in construction costs. The 8-story building has 80 deluxe apartments. Typical floors are 68′ x 165′ and cubic footage totals 1,020,000.

"We saved in many ways," says Mr. Roy Schoenbrod, the architect. "Designed and bid both for steel and for concrete, the steel bid proved to be decidedly less expensive. What's more, during construction we observed that steel construction made the job easier for the pipe trades such as heating, air-conditioning, conduits and plumbing. Work went faster and labor costs were reduced considerably. This was our first experience with steel on a building of this size, but now that we've seen what it can do, we'll think of steel first from now on."

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. . . savings readily apparent when steel bids are compared with material other than steel. What's more such savings accrue regardless of size of building—from horizontally structured apartment houses or hospitals to vertically-reaching hotels or office buildings. Earlier occupancy, interest savings on construction loans, lower labor costs, all contribute to make steel by far your best actual and potential value for every construction dollar.

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John B. Wilson, the twelfth engineer to be honored by the Indiana Society of Professional Engineers for "unusual and sustained contributions to the engineering profession and to public health, welfare and safety," is the first engineer in private practice so honored. Mr. Wilson, a consulting engineer with offices in Indianapolis, as well as president since 1940 of the Hoosier Water Company which serves seven Indiana towns, shared honors at the state society's annual convention with "Junior Engineer of the Year," **William E. Shaw.** Mr. Shaw, a graduate of Rose Polytechnic Institute, at the present time is an engineer-in-training. The occasion also marked the installation of **Harold L. Michael,** associate professor of highway engineering at Purdue University, as the new president of the State Society; **John F. W. Koch,** chief design engineer at the International Steel Company, as the new vice president; and **James M. Wade,** squad chief with the Indiana State Highway Commission, as treasurer.

J. B. Wilson

Robert R. Adams, after 12 years with Cornell, Howland, Hayes and Merryfield, at headquarters in Corvallis, Ore., has been taken into the partnership. As project engineer, in recent months he has been responsible for project design and supervision of construction on a water transmission line and reservoir for Hood River; a dam, reservoir and transmission line for Baker; and the relocation of the Union Pacific Railroad above the Ice Harbor Dam pool.

Gerald Luck transferred recently from the Alcoa Research Laboratories in Massena, N.Y., where he was research engineer to the company's Pittsburgh office. His present post is as structural engineer in the newly organized structural division.

William C. Overman, since 1958 associate engineer with Langley and McDonald, in Norfolk, Va., has been made a partner in the firm. Before joining Langley and McDonald, Mr. Overman held positions with Greeley and Hansen, in Chicago; the Sanitary Engineering Bureau of the Virginia State Department of Health; and with Frank D. Tarrall, Jr., and Associates, of Norfolk.

Benjamin F. Soffe, elected vice president-director of sales and a member of the board of directors of L*A Water Conditioning, Inc., in Glendale, Calif., brings to the firm over 35 years' experience in the field of water conditioning, having served in executive capacities with the Cochrane Corporation, the Liquid Conditioning Corporation, Stone and Webster and the Permutit Company. In addition he is credited with pioneering work in concrete roads in America, the design and construction of large treatment and water supply systems for many industries, as well as plants for municipal and power plant needs.

Harry Hayes, senior sanitary engineer and principal assistant to **Ray L. Derby,** currently principal sanitary engineer in the Los Angeles Department of Water and Power, has retired. He has been replaced by **Joseph M. Sanchis,** formerly sanitary engineer in charge of water treatment research and chlorination, and a member of the Department for some 27 years. **William K. Weight,** a 20-year staff member, who was sanitary engineering associate in charge of water quality investigations, has been advanced to Mr. Sanchis' former post.

Dale F. Baird is the new county engineer of Jefferson County, Colorado. Mr. Baird initiated, planned and directed many test programs while senior engineer at the Martin Company in Denver, where he has been employed for the past three years.

John J. Grimmer, formerly special project engineer with the Milwaukee (Wis.) Water Works, has joined the staff of Marquette University's Continuing Education Division in the new post of coordinator of business and industry services. Mr. Grimmer is a 1959 civil engineering graduate of Marquette and a candidate for a master degree there.

I. E. Boberg, Chicago Bridge and Iron Company engineering executive, was elected to the firm's board of directors on June 5. He has been chief engineer there since 1945 and for the past four years engineering vice president.

David W. Carmichael on July 1 ended 20 years as borough engineer of Verona, N. J. Mr. Carmichael plans to return to private practice as an engineering consultant and also to pursue studies interrupted in 1936 toward a doctorate. During a previous association with Fuller & McClintock of New York, he helped plan, improve and design water and sewerage systems in Albany, Ward's Island and Westchester County, New York.

Max S. Campbell, at the present time vice president and chief engineer of H. D. Fowler Company, Inc., of Seattle, Wash., was recently named to the Washington State Board of Health. His qualifications include service from 1941 to 1945 as chief sanitary engineer of the State Department of Health. Mr. Campbell is a past president of the Seattle Section.

Seymour Zubkoff recently resigned as project engineer from the DeLong Corporation of New York City, to become a principal engineer on the staff of the Hydrotechnic Corporation, consulting water resources, hydraulic and sanitary engineers of New York City. In his new position Mr. Zubkoff is in Saigon, in connection with the firm's engineering work for the new Saigon-Cholon Metropolitan Water Supply project for the Viet Nam Government.

(Continued on page 26)

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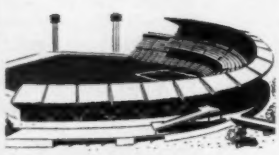
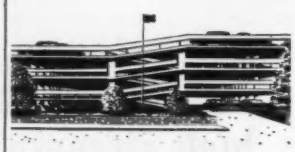
Overpasses

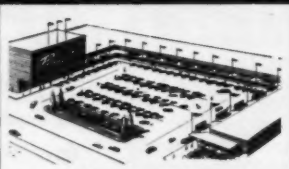


Stadiums



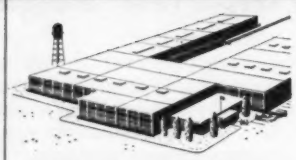
Parking Structures

Schools



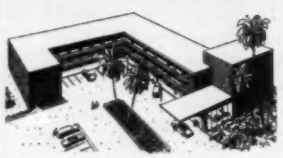
Shopping Centers

Bridges—Rail and Highway



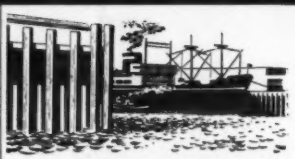
Industrial Plants and Warehouses

Churches



Apartments and Motels

Public Buildings



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INDIANA American-Marietta Company, Lafayette • Shute Concrete Products, Richmond

IOWA A & M Prestress, Clear Lake • Midwest Concrete Industries, West Des Moines • Prestressed Concrete of Iowa, Iowa Falls • C. W. Shivvy Co., Waterloo

KANSAS Russell Ralph Co., Topeka • Sunflower Prestress, Inc., Salina • United Prestress Co., Wichita

LOUISIANA Bolden Concrete Products, Inc., Metairie • Prestressed Concrete Products Co., Inc., Mandeville • Mid-State Prestressed Concrete, Inc., Alexandria

MARYLAND Baltimore Concrete Plank Corp., Baltimore

MASSACHUSETTS New England Concrete Pipe Corp., Newton Upper Falls • Northeast Concrete Products, Inc., Plainville • Sun-Vel Concrete Corp., Littleton

MICHIGAN American Prestressed Concrete Inc., Centerline • Lamar Pipe and Tile Company, Div. American-Marietta Company, Grand Rapids • Precast Industries, Inc., Kalamazoo • Price Brothers, Livonia • Superior Products Co., Detroit

MINNESOTA Cretex Companies, Elk River • Prestressed Concrete Inc., St. Paul • Wells Concrete Products Co., Wells

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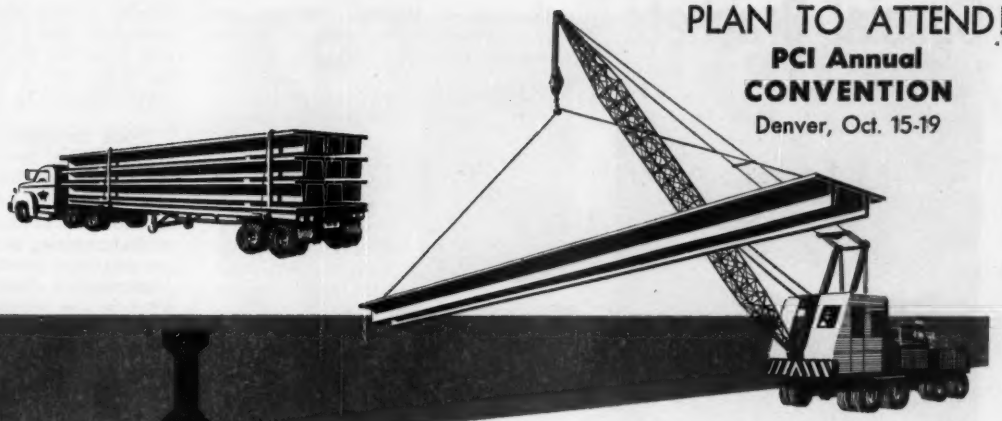

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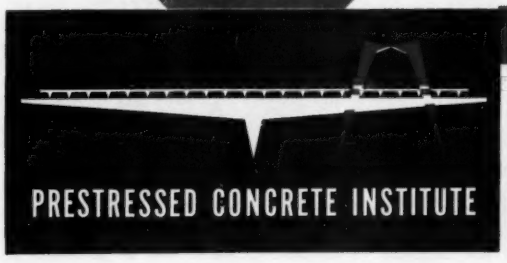

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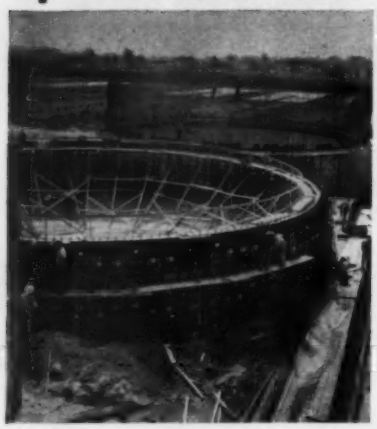

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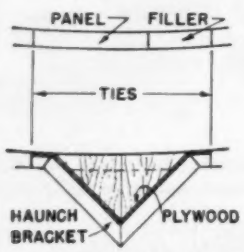

Plan view of special haunch brackets used horizontally on first lift.

were modified to comply with the job requirements. Result: 22 brackets were re-used four times at a price far below what it would have cost to job-build each bracket.

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MORE **SAVINGS** FROM **SYMONS**

Theodore R. Higgins, engineer and scientist, received the Honorary Degree of Doctor of Engineering from Lehigh University on June 12, "in recognition of his achievements and influence in the field of engineering and of research." Long active in engineering affairs, Mr. Higgins before assuming his present position as director of engineering and research for the American Institute for Steel Construction, was associated with the Massachusetts State Highway Department, the Santa Fe Railroad in Texas, the Stone and Webster Corporation in Boston, and the New England Structural Company in Everett, Mass. Recently he served as a member of the four-man team that surveyed the structural damage caused by the 1960 earthquake in Agadir, Morocco.

Robert D. Dewell, a prominent consulting engineer of San Francisco, Calif., recently joined J. H. Pomeroy & Company, Inc., as chief engineer. Active as a consultant for the past 16 years, his most recent projects are the International Building in San Francisco and the Chemistry Complex at the Berkeley Campus of the University of California, both of which are presently under construction.

Lawrence F. Wagner has recently been reappointed for his third five-year term as the county engineer of Ocean County, New Jersey.

Desi Vasarhelyi, promoted from assistant professor of civil engineering to professor, is one of several recent changes at the University of Washington. **Dale Carlson, Joseph Kent** and **Ronald Nece,** also of the Department of Civil Engineering, have been named associate professors, while the Department of General Engineering has advanced **Vernon Hammer** to executive officer, **Robert Seabloom** to associate professor and **Robert Albrecht** and **Richard Long** to assistant professors.

Andrew M. Komora, who from 1950 to 1959 held the post of chief engineer for the Damodar Valley Corporation in India, has resigned from his present position of project manager with the Bechtel Corporation in San Francisco in order to establish himself as an independent consulting engineer.

John E. Everson, elected to partnership in the New York firm of Parsons, Brinckerhoff, Quade & Douglas, has been associated with the firm for 17 years. During the past two years as head of the San Francisco, Calif., office he was engaged largely in the development of plans for a rapid transit system for the Bay Area, in which capacity he will continue. **John O. Bickel,** after being with the firm for some 30 years, nine of them as a partner, although now retired, will continue in active association with the firm as a consultant. Mr. Bickel has been responsible for the design and development of a number of underwater and land tunnels, numerous waterfront projects, and several large dry docks among which was the latest dry dock in the New York Naval Shipyard in Brooklyn.

Frank Bromilow becomes dean of engineering and director of the Engineering Experiment Station at New Mexico State University on September 1, after several years as head of the University's civil engineering department. An instructor and later assistant professor at the University of Pittsburgh from 1937 to 1946, he was subsequently chief engineer for the Plasteel Products Company from 1946 to 1948, and a member of the engineering faculty at the University of Florida from 1948 to 1951. Professor Bromilow will be succeeded as department head by **John W. Clark,** professor of civil engineering, and a NMSU faculty member since 1953.

Joseph D. Bonness, Milwaukee, Wis., contractor, was honored by Marquette University at commencement exercises June 4 as the 1961 "alumnus of the year." Chairman of the board of Joseph D. Bonness, Inc., he also heads Highway Pavers, Inc., and Koch and Bonness, Inc.

Sydney M. Harris will work out of the New York office of the Eimco Corporation as a sales engineer in the Process Engineers Division. Since graduating from the City College of New York recently, Mr. Harris, who is completing work there toward a master's degree, has been affiliated with Seeley, Stevenson, Value and Knecht and with Parsons, Brinckerhoff, Quade and Douglas, New York City firms.

Ernest M. MacDonald following 30 years of State service retired recently from the California Division of Highways where he has been assistant chief right of way agent in charge of appraisals since 1947. Prior to 1947 he was senior valuation engineer with the California State Board of Equalization.

S. C. Hamilton, of the Chicago Bridge & Iron Company, has been elected a senior vice president of the firm's contracting department. Mr. Hamilton, whose company career spans 33 years, has been a director since 1946 and was vice president of sales for some four years. The newly elected vice president of research, **J. T. Horton,** was formerly manager of special designs and estimating. He joined the company in 1955 and has been a director since 1959. **Edward S. Fraser,** presently vice president in charge of manufacturing, has been elected to serve as a director. His previous company service dates back to 1939 and includes several years each as manager of the Salt Lake fabricating plant and as assistant sales manager.

Benjamin F. Rose, Jr., manager of the Aerojet-General Corporation's AEtron Division at Covina, Calif., last month was elected a vice president of the Corporation. Since joining the company in 1947, he has directed Aerojet's great complex of solid and liquid rocket test stands at

Sacramento and major plant structures, representing the foremost facilities in the rocket industry, were designed and constructed under his supervision during the past decade at both Azusa and Sacramento. A retired Colonel of the Corps of Engineers, he was awarded the Legion of Merit for supervising construction of numerous facilities in the Southwest Pacific area during World War II.

George N. Martin has been promoted from vice president to president of the Bates & Rogers Construction Corporation, of Chicago, Ill. In addition **John W. Rogers** was elected senior vice president and treasurer, and **A. F. Reichmann, Jr.,** was elected vice president and chief engineer.

Wayne S. Byrne, formerly manager of Overseas Construction Operations for the Utah Construction and Mining Company, and for many years associated with the U.S. Bureau of Reclamation, has announced the opening of a consulting office in San Francisco. Mr. Byrne will deal in all phases of heavy construction projects.

George L. Sodemann, of Sodemann and Associates, consulting engineers of Champaign, Ill., after serving this past year as vice president of the Illinois Association of Consulting Engineers, was elected Association president recently. Serving with Mr. Sodemann as secretary is **Robert Hofmann,** of Robert Hofmann and Associates. **Junius R. Gardner,** principal engineer of Warren and Van Praag, Inc., has been named a delegate to the Consulting Engineers Council.

John M. Beatty, whose entire teaching career dating back to 1929 has been spent at Rensselaer Polytechnic Institute where he is currently professor in the Civil Engineering Department, on July 1 was named executive officer of that Department. In addition to his teaching duties, he has served as a consultant for the Hartford (Conn.) Fire Insurance Company, Colt's Patent Fire Arms Manufacturing Company, Solomon and Keis (now Keis and Holroyd), Troy, N. Y., architectural firm, and the Manufacturer's National Bank of Troy.

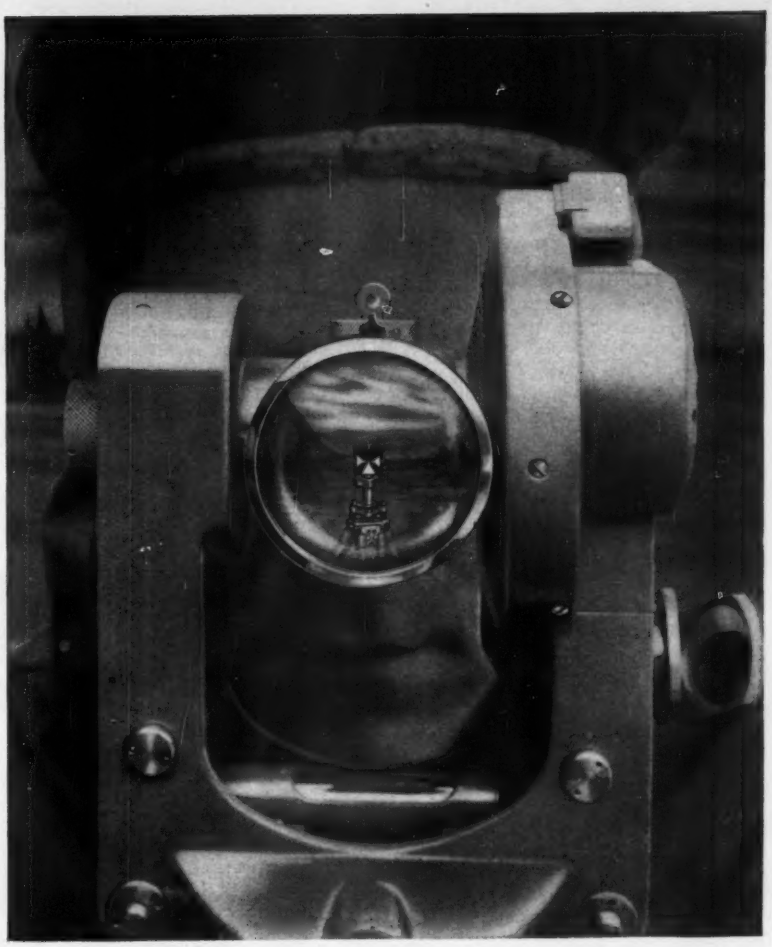
Ernest L. Spencer, a member of the engineering faculty at Northeastern University since 1939, has been named the new head of its civil engineering department replacing **Charles O. Baird, Jr.,** who is currently at work on expansion

C. O. Baird, Jr.

E. L. Spencer

plans for the University in his capacity as full time university engineer. Professor Spencer in past years has served as president and secretary-treasurer of the Massachusetts Section and as secretary and chairman of the New England Council, ASCE.

(Continued on page 101)



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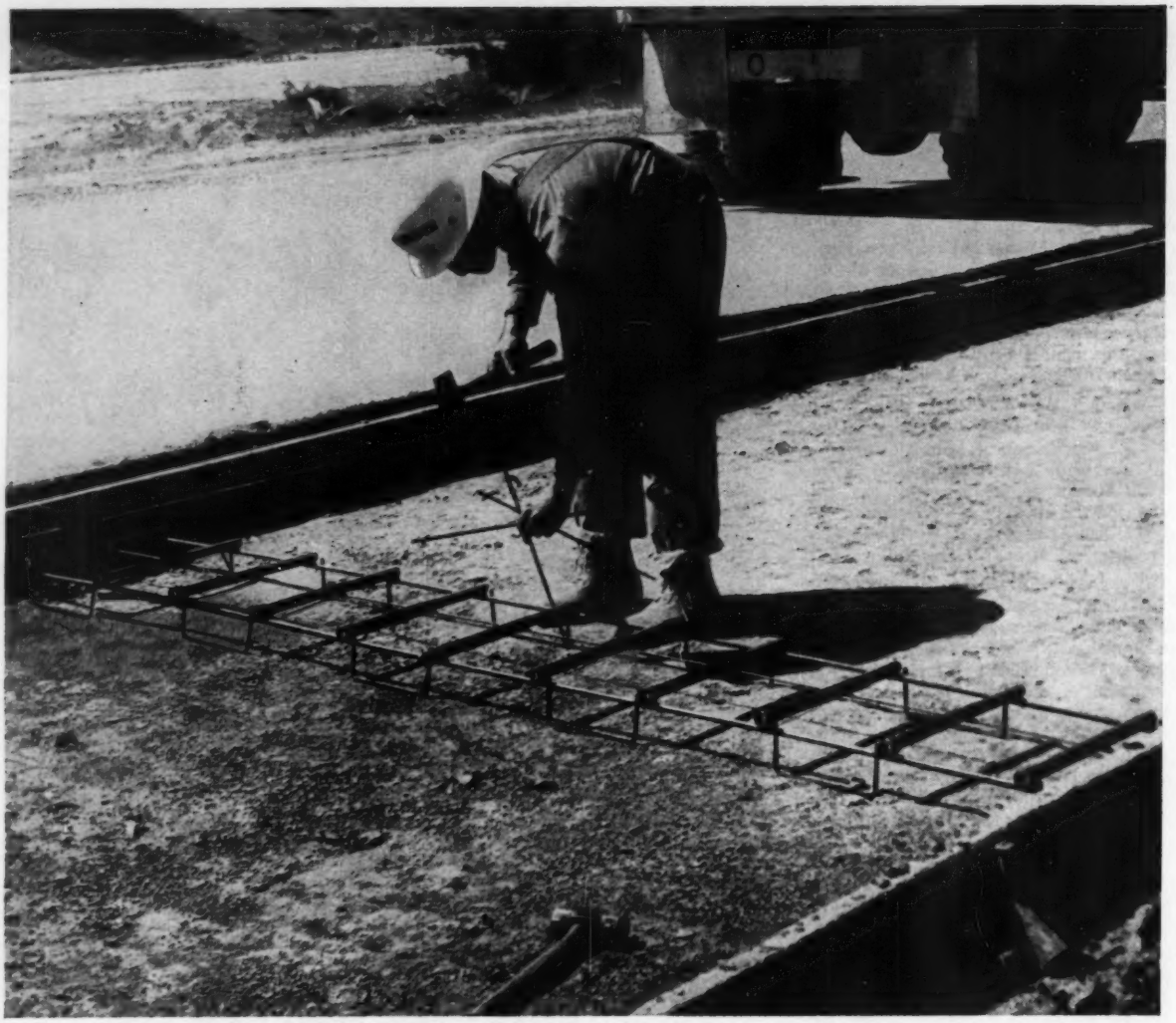

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. . . . . *Am-Soc Briefs*

▶ ▶ The waning summer will find ASCE and its fellow engineering societies—eighteen of them, all told—lodged in their new home, the United Engineering Center. The big move will be made over Labor Day weekend. . . . The UEC will be on display to members attending the Annual Convention in October at an Open House, set for the 19th. . . . Former President Herbert Hoover—Honorary Member of ASCE and from the first an enthusiastic supporter of the UEC project—will be honorary chairman at dedication ceremonies, planned for late in October.

▶ ▶ New address. . . . Beginning September 5, all correspondence for ASCE and "Civil Engineering" should be sent to our new address: American Society of Civil Engineers, United Engineering Center, 345 East 47th Street, New York 17, N.Y.

▶ ▶ The amended Code of Ethics—printed with a Guide to Professional Practice Under the Code, in the June issue—has been ratified by a 12,599-to-528 vote of the membership. Put another way, 96 percent of the eligible votes cast were in favor of the proposed amended Code, which had been prepared by the Society's Committee on Professional Practice and approved by the Board of Direction. Copies of both the existing and proposed Codes, plus the guide to help clarify rules of conduct, had been sent to all members, along with their mail ballots.

▶ ▶ Speaking of professional practice, recent letters explaining the ethical ideas of ASCE—sent out from Society Headquarters—are thought to have been instrumental in stopping legislation that would have required competitive bidding on most public engineering and architectural design work in Missouri. ASCE Headquarters was alerted to the legislation by Prof. E. W. Carlton, F. ASCE, at the Missouri School of Mines.

▶ ▶ Pay rates for civil engineers are up again. . . . Uptrends are seen in eleven of fifteen key U.S. cities and four of six major geographical regions, on the basis of data solicited from a picked group of consulting firms and state highway departments. The new summary of engineering salaries, as of June 30, appears on page 71.

▶ ▶ Added service. . . . With this issue (page 121), ASCE initiates a special page of coupons, which will simplify changing your address, indicating your Division enrollment, and ordering Proceedings papers.

▶ ▶ As a salute to Public Works Week, October 1-7, the September issue of "Civil Engineering" will feature public works. Coverage will include sewage and water treatment plants, highways, and urban renewal.

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do you know that

The TVA has cut its rates to a national low? The cut—at least 8 percent—in the cost of electricity to residential and commercial consumers in the Tennessee Valley area will provide the lowest rates in the nation for electricity used in the average home. The rate reduction was announced by the TVA board at a recent White House ceremony honoring the centennial of the birth of Senator George W. Norris, of Nebraska, one of the authors of the 1933 act establishing the Authority.

▪ ▪ ▪

Chicago's Union Station will be surmounted by a mammoth office building? The same American and British interests involved in constructing the 59-story Pan American Building, now going up over the tracks north of New York's Grand Central, have joined in a similar venture in downtown Chicago. Plans for the development of a complex of office buildings on air rights over seven and a half acres of Chicago Union Station property have just been announced by the president of the Union Station Company. And in New York, a new Madison Square Garden will be built on top of Pennsylvania Station as part of a $50,000,000 complex that will include sports arenas, offices, restaurants, convention halls, and a hotel. The new "Garden" will be a saucer-like structure with seats for 25,000.

▪ ▪ ▪

There is stepped-up interest in pollution abatement? A major sign of interest is recent Congressional approval of a broadened clean-up program. Other straws in the wind: The Bureau of Reclamation has awarded a $3.2 million contract for construction of an earthfill dam on Spring Creek, above Redding, Calif., which will permit dilution of pollutants, said to be killing thousands of salmon in the Sacramento River; the Public Health Service has awarded contracts totaling $46,000 to Brooklyn Polytechnic Institute and Harvard University for study of advanced sewage-treatment techniques; and the PHS is investigating pollution in the New York Harbor area.

▪ ▪ ▪

This year marks the golden anniversary of Roosevelt Dam? To celebrate the dedication, half a century ago, of this initial structure in the Salt River Project, *Arizona Highways* recently dedicated a striking special issue to the role of the project in the development of the arid Southwest. The special issue, called "Water and the Thirsty Land," may be purchased from *Arizona Highways*, Phoenix, Ariz., for 40 cents.

▪ ▪ ▪

The Passamaquoddy Project is not entirely a dead issue? President Kennedy has asked Interior Secretary Udall to review an unfavorable report on the project, recently released by the International Joint Commission, to see if it could be made economically feasible. The report put the cost of the project at $687,000,000 and said it would not compare economically with the cost of power from steam plants in the same area. The controversial Passamaquoddy Project for harnessing the tides between Maine and New Brunswick was started in the early thirties and then dropped.

▪ ▪ ▪

The highway traffic fatality rate declined in 1960? The rate of 5.3 per 100 million passenger miles represented a slight drop from the 1959 rate of 5.4. For these figures, our thanks to *Better Roads*.

▪ ▪ ▪

New York spent more on port construction in the postwar years than any other U. S. city? During the 1946-1960 period the Port of New York Authority spent $269,000,000 on rehabilitation of ocean-going ship facilities in the metropolitan harbor area—almost five times more than was spent by any other port. Montreal, with expenditures of $87,000,000, headed the list of Canadian ports, and Los Angeles, with $60,000,000 spent, was second to New York among U. S. ports. Total layouts for all North American ports came to almost $1.5 billion.

▪ ▪ ▪

The AMA has approved a $20 dues increase? The American Medical Association's policy-making body, the House of Delegates, has approved an annual dues increase over the next two years. A $10 increase will go into effect next January, and another the following January. The dues have been $25 a year since 1950.

▪ ▪ ▪

All new structures projecting 150 ft in the air must be approved by the Federal Aviation Agency? This new regulation, which applies to alterations too, requires notice to the agency at least 30 days before start of work on any project exceeding 150 ft in height, or extending into an airport or landing area, or within 500 ft of the centerline of any runway. The regulation provides criteria for determining the effect of proposed structures on air navigation, with procedures for hearings and appeals.

▪ ▪ ▪

Over $5 billion will be spent in the 1961 world steel race? According to the American Iron and Steel Institute, the fast-moving contest is being waged on every continent. The largest outlay for any country or region will be made by U. S. companies, which are expected to lay out $1.2 billion for expansion and modernization this year. Russia's estimated outlay is about $1 billion, while Great Britain and western Europe will probably spend close to $1.1 billion.

Five concrete steps to urban renewal

New Orleans has a new heart these days...

A new Civic Center, replacing seven square blocks of slum area. Its five superb buildings create a new focal point for civic activities—and for future downtown development.

Extensive use of concrete in all five structures testifies to concrete's adaptability and its many benefits. Fire safety and structural strength, of course. Lightness—or impressive solidity. Beauty as well as enduring utility. All within a framework of economy.

New Orleans' new Civic Center is an impressive guidepost for urban renewal anywhere. The cement? Lone Star Portland throughout.

1—City Hall. 2—Main Library. 3—State Supreme Court. 4—Civil Courts Building. 5—State Building.

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CIVIL ENGINEERING

Projects for hydraulic research

By the Committee on Research of ASCE's Hydraulics Division

J. H. DOUMA, W. B. LANGBEIN, J. M. ROBERTSON, V. A. VANONI and C. F. WICKER, Chairman

A long and varied career in the encouragement of hydraulic research lies behind the Research Committee of the ASCE Hydraulics Division. Since it was reconstituted a few years ago, the committee has reviewed such research work in progress and collected a list of some fifty areas in which it is needed.[1] To convince prospective sponsors that there are many vital problems of hydraulics in need of detailed study, the committee has chosen eight examples to discuss here. These examples have been chosen to cover the widest possible range even at the expense of possible encroachment on areas which other Divisions of the Society may consider to be theirs.

The two conferences on research in civil engineering[2, 3] arranged by the Society's Committee on Research, have done much to delineate the general research problem. There must be more concern with basic questions in science and technology for at least two reasons. First, as the profession develops it becomes more and more necessary to understand basic phenomena. Second, it can no longer be assumed that others (the physicist for example) will continue to study basic problems in hydraulics.

In presenting the following projects in which immediate research is needed, much abbreviation has obviously been necessary. Also, since there is hardly a problem on which some effort has not been expended, previous studies are briefly indicated.

A. Sediment motion in a stream

When a stream flows over a bed of loose sediment at a gradually increasing velocity, engineers know from experience that a critical value will be reached at which sediment motion will be initiated. The critical conditions under which a flow begins to move sediment are of both practical and theoretical interest. This problem is of practical importance in the common case of the design of stable channels in erodible material. This case involves not only the stability of bed material, but also that of bank material, and more knowledge could form the basis for the design of riprap for bank revetment. From the theoretical point of view, the beginning of motion appears to be one case that can be worked out with relative ease. Once it is understood, it may lead to the clarification of much more complicated cases where appreciable quantities of sediment are in motion.

Factors affecting the initiation of motion of sediment are of two kinds: those that determine the flow, and those of the bed. Important factors include the structure and intensity of turbulence, especially near the bed, and the change of these factors with distance along the stream.

Most studies of the problem of the critical tractive force of sediments have been carried out in flumes under conditions of uniform steady flow, with fully developed turbulent velocity profiles. This is probably the most important case encountered in practice, but to understand the general case, other studies must be made. For instance, much can be learned by extending the work of C. M. White,[4] where variations can be made in the turbulence and in the velocity profiles along the stream.

Since the initiation of sediment movement seems to be a critical one, which occurs once flow conditions have passed through some critical value, it is difficult to study the problem without getting into the range of very low transport rates. This naturally leads into the very important problem of the formation of dunes in the bed sediment, as studied by A. Shields,[5] and more recently by H. K. Liu.[6]

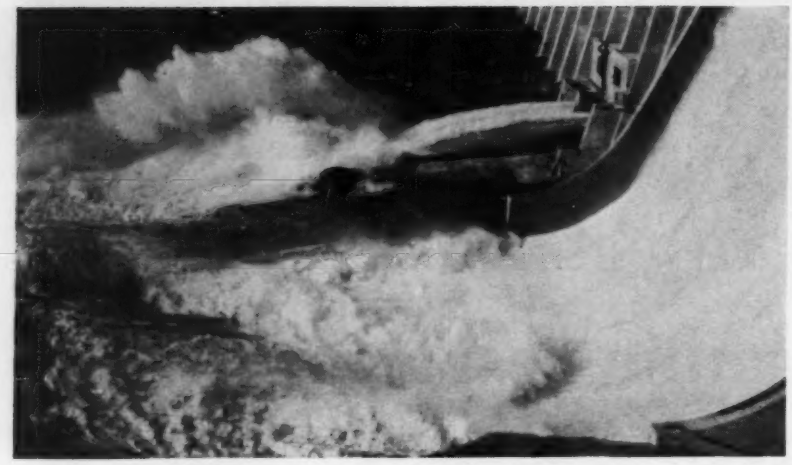
B. A submerged jet in a flowing stream

This flow problem is encountered when sewage is discharged into a river or ocean current or when waste gases are discharged into the atmosphere with a wind blowing. The problem is usually to get proper mixing and dilution of the pollutant in the surrounding flow.

Many factors must be considered in the research studies, among them the relative velocities and directions, turbulence structures, the densities of the two streams, and the nature of the pollutants, whether in solution or consisting of particles. Recent work[7, 8] concerned with jet diffusion into a denser or lighter fluid has been primarily related to cases where the receiving fluid is at rest except for the jet-induced motion.

In doing research on submerged jets, hydraulic engineers should be careful to relate their work to that done by other professions—such as chemical engineering (industrial mixing), mechanical engineering (jet pumps, jet propulsion, fuel injection), and meteorology (air pollution).

For sewage disposal in sea water, the velocities are not very large, while the relative density difference between the jet and the receiving fluid is greater than in most other jet prob-



lems. Thus, it is up to the civil engineer to explore the range of these variables of interest to him, as the complete answers will not be found in the research of others.

C. Mechanics of stratified flow

A stratified fluid is one in which the fluid density varies by virtue of differences in temperature, dissolved salts or suspended sediment. The engineering profession has only begun to recognize the importance of a better understanding of the mechanics of such flows and methods of controlling them.

Control structures are now in use to provide cooler water at the condensing water intakes of steam power plants.[9, 10] Lakes and artificial reservoirs have been proposed as heat exchangers for water-cooled nuclear power plants, thereby making it necessary to design intakes to withdraw the low-level cool water and to distribute the inflow of warm water near the surface. The use of the thermal stratification in tropical seas as a source of energy for thermal power plants has raised the question of the degree of selectivity that exists at an intake in a fluid having a vertical density gradient.

The reduction of reservoir sedimentation by removal, at the dam, of water containing large amounts of suspended sediment has been suggested as a means of prolonging the useful life of major reservoirs. Reduction of evaporation from reservoirs by preferential discharge of the warmer surface layer, and thus removal of excess heat, has also been suggested to abate consumptive waste of water. The many problems resulting from salinity intrusion in estuaries, and the possibility of control by salinity barriers, also illustrate the economic importance of research in stratified flow.

A large amount of useful experimental and analytical work has been accomplished but much remains to be done. Much support has come from organizations outside the civil engineering profession and has been pointed toward problems of interest to meteorologists, oceanographers, etc.[11, 12] Many of the past experimental studies have been relatively small-scale ones in which the flows were predominantly laminar. Probably the most important research need is for investigations in the turbulent regime. This will require larger and more expensive equipment than has been previously used.

The principal unknowns are the velocity distributions and shear stresses in the vicinity of the interface. Experiments should be conducted at equal Reynolds numbers and density differences using both dissolved salts and suspended sediment. The question of the existence or definition of an "interface" in highly turbulent density currents in which mixing is taking place also needs clarification.

D. Forces on hydraulic structures

Flow in many important hydraulic structures is too complicated to be analyzed by mathematical means and must be studied by models, an expensive method. If there were a means of calculating these forces, in many cases it would be possible to obtain reliable designs without model studies.

In the design of stilling basins for reservoir spillways and outlet works, use is made of baffle piers, end sills and training walls on which hydraulic forces are exerted by high-velocity flow. Although many stilling basins have been model tested by the Bureau of Reclamation, the Corps of Engineers, and others,[14, 15] more data are needed to determine specific criteria whereby forces on these structural elements can be found by analysis.

Another need is for criteria whereby hydraulic forces exerted on spillway Tainter gates by waves can be determined for structural design of the gates. These wave pressures create an added load which has been ignored in past practice and becomes very significant for high waves on large gates. An analytical method, requiring experimental verification, similar to Sainflou's method [16] for computing the pressures of a wave striking a vertical wall should apply to the case of a Tainter gate.

The flow and resulting forces on elements of hydraulic structures are influenced strongly by geometric arrangement of the elements. Since the geometric arrangement varies greatly, it is impractical to undertake general studies of them all and the research worker must select geometries that are

commonly used by a great number of organizations. This means selecting structure types and then exploring the forces on elements of these structures. One such hydraulic structure is the hydraulic jump stilling basin used commonly at spillway outlets. It would be useful to hydraulic engineers to know forces on the various baffles and end sills in such structures. These forces could then be used in the momentum equation and a satisfactory design determined analytically.

E. Transport of rainwater

For many years hydraulic engineering has been concerned with the management of the larger streams—for irrigation, water supply, navigation, water power, or flood control. Large streams tend toward uniformity and so generalized measurements of rainfall and runoff were usually sufficient. However, there is increasing public concern with the smaller streams, among which the diversity is so great that generalized rules, such as the unit hydrograph or channel-storage routing, are no longer satisfactory.

A host of measurements on rainfall input and runoff output from small watersheds are available, but there is as yet no general theory to explain the course or mechanics of the flow from input to output.

The emphasis in hydrologic upland research should shift from the collection of data to an examination of the details of the mechanics of the flow of water from the time it strikes the land surface until it reaches the ground water and ultimately the streams. The leading research on this subject is now 25 years old.[17] Aside from Izzard's work [15] on the mechanics of overland flow, very little progress has been attained since then.

Emphasis should be given to specific observations of the flow of water along a particular slope and through particular cross-sections. Chemical sampling of, say, silica, may be instructive, as well as radioactive tracers such as tritium-water.

This kind of research has the advantage that it can be broken into simple elements for study by a university group, without costly collection of data from a watershed. This is exemplified by Izzard's [15] work with relatively simple instrumentation.

F. Operations research for design

Engineering projects for water-resources development have as their stated objective the attainment of maximum gains for an investment of public or private funds. This is the grand objective to which all others are subordinate. If the engineer's job ends with the efficient and safe design of structures, he is then merely a diligent mechanic who gives substance to the ideas of others who decide on the size, arrangement, and scope of the development on subjective grounds. The engineer can, on the other hand, put a firm objective base under such major decisions.

The techniques that need to be explored are those now being productively applied as operations research in industry. Few hydraulic or civil engineers are aware of the pioneering work along this line by P. Masse [19, 20] in France, although some work both by engineers and others [21, 22, 23] at Stanford University, Harvard University School of Government, and the UCLA College of Engineering has broken new ground.

Much work is needed merely to adapt available approaches to engineering problems. Both specific situations and generalized approaches need to be considered.

G. Flow-induced oscillations

When a bluff body is placed in a flow, an unsteady wake will be formed downstream. Vortices are shed from the trailing edges of the body, alternatively from one side and then from the other, leaving a staggered pattern of vortices in the wake. Up to moderately high Reynolds numbers, the double-row vortex pattern is readily identified and is known as the Karman vortex street.[24] At higher Reynolds numbers the staggered pattern becomes diffused. These forces can set up serious oscillations in a structure as shown by the failure of the Tacoma Narrows bridge due to wind-induced oscillation.

The structures proposed for study here are much simpler than a suspension bridge, consisting mainly of a single unit with relatively few degrees of freedom. Examples of such structures are smokestacks, towers, and slender bridge columns; and pumps, turbines, and propellers submerged in flowing water. The lack of information on flow-induced oscillations has often resulted in serious trouble after structures have been erected. This is in spite of considerable recent research on this long standing problem.[25, 26, 27]

In spite of the excellent work of A. Roshko [24] there is much to learn about how the oscillating flow develops. Similarly, the few cures for oscillations [25, 26] are hardly adequate for all problems.

H. Ship waves in shallow channels

The passage of a ship in a shallow or otherwise restrictive channel may cause serious disturbances. In concert with other effects, surge can cause much damage to the banks of the waterway, as well as to shoreline structures and moored vessels. Smaller craft, however, produce large bow and stern waves that may cause considerable damage.

There is need for better definition of the relationship between causes and effects, and more information on the nature and magnitude of the disturbances. Such information will be helpful to regulatory agencies in setting speed limits for various classes of vessels, also to designers of piers, quays, bulkheads, and channel improvement projects. Since there is little information in the literature on this subject, it is likely that the design of shoreline structures to resist wave action generated by ships is based entirely on empirical considerations.

It might be expected that the naval architects would have considerable material on this question, but such does not appear to be the case. Thus the study reported by Lee and Bowers [29] in regard to ship behavior and steering in restricted channels and bends of the Panama Canal gave as references a mere dozen relevant studies. The initial phases of the general study should involve both model studies and systematic observations in a prototype waterway. This reconnaissance should produce a range of conditions that would be helpful in planning a more detailed investigation.

Restriction of projects

Eight broad problems needing hydraulic research have been indicated. In each case to define a reasonable research project the problem must be further limited to some specific facet. Furthermore each investigator or sponsor has his own inclinations. Often, because of the nature of the sponsorship, the project will automatically be limited. However, investigators and sponsors alike should keep in mind that this is part of a much larger general problem and exercise great care not to limit the usefulness of their specific result in the eventual understanding of the overall problem. Proper selection of variables and ranges of study will permit the achievement of significant contributions to the general problem.

Support for research

Support for research is a long standing problem for which the Hydraulics Research Committee has no direct solution. One of the problems [cf. 2, 3] of supporting research in the civil engineering field is that most activity is associated with specific

structures and hence is of an applied nature. Those responsible for such works need to realize that they are borrowing from their predecessors and have a responsibility to the future. In many cases design studies for a specific project are capable of moderate expansion in time and effort that would lead to contributions to basic knowledge. Where such extensions into the fundamentals of the problem are made nowadays, it is usually through the strong motivation of the person who does the study and this often involves a great deal of his own time and effort. Such people should be given formal authority and backing.

Besides such structures-bound research, the civil engineering profession needs to support generalized research. There are some public organizations such as government agencies, that can and do sponsor such work. Additional support for research more closely associated with the civil engineering profession and its associated industries must be developed.

The research problems that have been discussed here are subject to potential support from a variety of organizations. Thus the project for the improvement of techniques for the design of stilling basins is of interest to many public and private organizations such as flood control districts, irrigation districts, water departments of states and municipalities, public utilities and even farmers, besides the large federal agencies. But in a broader sense this is a problem for which the profession should accept responsibility, since civil engineers may work for, design for, consult for, advise, or manage one of the organizations mentioned. Most of the projects that have been discussed are obviously the responsibility of the profession and industry as a whole.

Some of the projects may be supported, in part at least, by the organizations that are facing the specific problems. Thus the inhibition of oscillation in structures will be studied by public utilities with smokestacks, highway departments with bridge members, and broadcasting companies with antenna towers. Similarly, the principles of submerged jets and stratified flow will certainly be studied in connection with specific projects or structures. However, these specific studies must be supplemented by basic studies of the fundamental phenomena involved. It is the responsibility of the civil engineering profession to see that this latter type of research is adequately supported and carried out.

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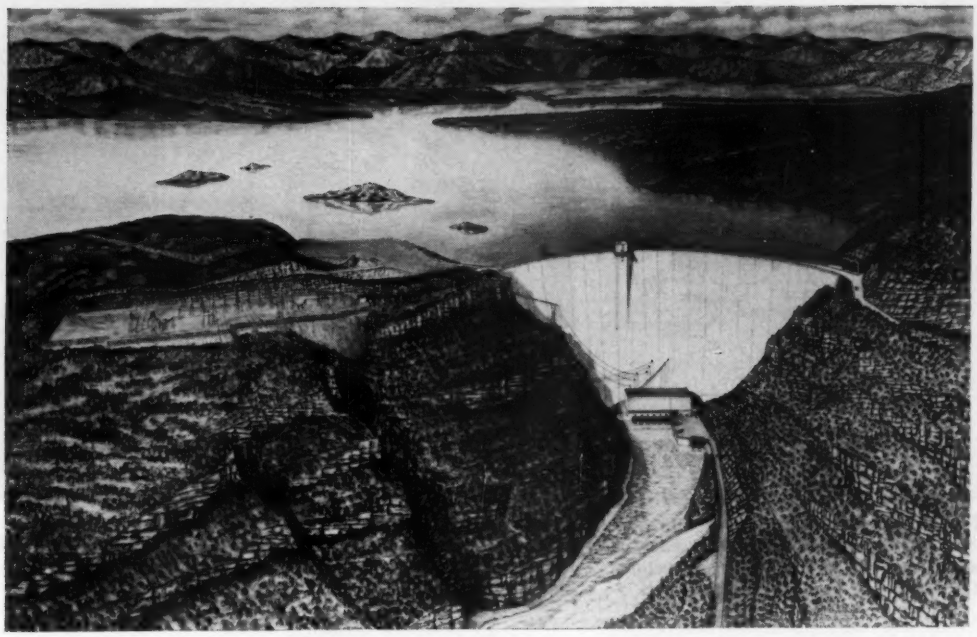
Acknowledgements

The paper of which this article is a condensation is the result of several years of effort on the part of the members of the Committee on Research of the ASCE Hydraulics Division. The work of the Division's Hydromechanics Committee in drafting a set of ten research proposals was of great help in developing the present set of projects. The third and fourth projects discussed are generalizations of two of these ten projects; specific thanks are due D. R. F. Harleman, formerly of the Hydromechanics Committee, for his help in drafting the third project, on stratified flow. Special credit is also due to J. M. Robertson for his work in preparing the original draft of this article for the committee.

Several of the proposals may appear more general than might be assumed to be included under a narrow definition of hydraulics. The committee has not concerned itself with this question since the objective is to promote research wherever it may be needed. However, to avoid missing pertinent concepts or information as well as possible duplication in effort, this paper has been referred to the Fluid Dynamics and Research Committees of the Engineering Mechanics Division, the Atmospheric Pollution and Research Committees of the Sanitary Engineering Division and the Research Committees of the Structural and Waterways and Harbors Divisions. The Hydraulic Structures, Sedimentation and Surface-Water Hydrology Committees of the Hydraulics Division have also been consulted. The constructive comments of these committees are gratefully acknowledged.



Artist's conception of completed dam. The 108,000-kw powerplant is at toe of dam and switchyard is on cliff at left.

Flaming Gorge Dam

MAX FORD, Engineer, Dams Branch, Division of Design, Bureau of Reclamation, Denver, Colo.

Flaming Gorge Dam is a concrete arch structure built in a deep canyon as one of four storage units in the Colorado River Storage Project. The dam will have a height of 502 ft above the lowest foundation, a crest length of 1,180 ft, and a base thickness of 130 ft at the plane of centers (that is, the plane containing the centers for arcs which form the contours of the dam's faces). Concrete volume will be about 960,000 cu yd. The power plant is planned for three generators with a capacity of 108,000 kw. During construction the river is being diverted through a concrete-lined tunnel 23 ft in diameter, driven at river level through the rock of the abutment. An inclined spillway tunnel through the left abutment will discharge a maximum flow of 28,800 cfs.

Flaming Gorge Dam is under construction in northeastern Utah on the Green River, a tributary of the Colorado. The dam site is six miles south of the Utah-Wyoming line and 20 miles west of the Colorado line. Construction of the dam and power plant began in July 1958 under a contract awarded to the Arch Dam Constructors, a joint venture composed of Peter Kiewit Sons' Company, Morrison-Knudsen Company, Inc., Mid-Valley Utility Constructors Inc., and Coker Construction Company, Inc.

The reservoir to be formed by the dam will have a capacity of 3,789,000 acre-ft and will extend 91 miles, almost to the town of Green River, Wyo. It is a major unit in the Bureau of Reclamation's Colorado River Storage Project to develop the land and water resources of the Upper Colorado Basin, an area of 110,000 sq miles containing a rich potential of agricultural, industrial and recreational assets. The other three storage units of the project are Glen Canyon in Arizona (CIVIL ENGINEERING, July 1961, p. 50), the Curecanti Unit in Colorado and the Navajo Unit in New Mexico. See Fig. 1.

Principal all-weather access to the site at present is from Green River, Wyo., located 63 miles to the north of U. S. 30 and on the Union Pacific Railroad. The new permanent community of Dutch John, named after a pioneer settler, has been constructed

FIG. 1. Three units in Upper Colorado Project—Flaming Gorge, Glen Canyon and Navajo—are under construction. Curecanti will be built in units later.

At upstream end of spillway tunnel, muck is dropped through a pilot tunnel excavated on a 55-deg incline to the previously excavated horizontal section of the spillway tunnel. Tunnel supports will be required only at the entrance; elsewhere rock bolts will be adequate.

by the Bureau of Reclamation about two miles from the dam. It will provide housing during construction and later for operating personnel.

Tilted bedrock at the site

Bedrock at the site is quartzite and sandstone of Pre-Cambrian origin. Much of the abutment rock was covered to some degree with slope-wash talus and a minor amount of residual soil. The bedrock has a general dip of 15 deg upstream and towards the reservoir. The rock ranges from a moderately hard sandstone cemented with silica to a very hard quartzite. Interspersed are zones of varying thicknesses of interbedded lens-like layers of shale, siltstone and sandstone in varying proportions. These zones vary in thickness from less than 1 ft to 12 ft. Individual shale layers range from paper-thin to about 4 ft. There are no significant faults within the foundation area of the dam but there are two prominent faults or shear zones in the immediate area.

Extensive laboratory tests of cores from exploratory drill holes indicated foundation rock of satisfactory strength and characteristics. The rock has a specific gravity of 2.54, absorption of 2.12 percent and porosity of 5.38 percent. The compressive strength ranged from 17,400 psi at 75 percent saturation to 22,000 psi dry, with a tensile strength of 470 psi.

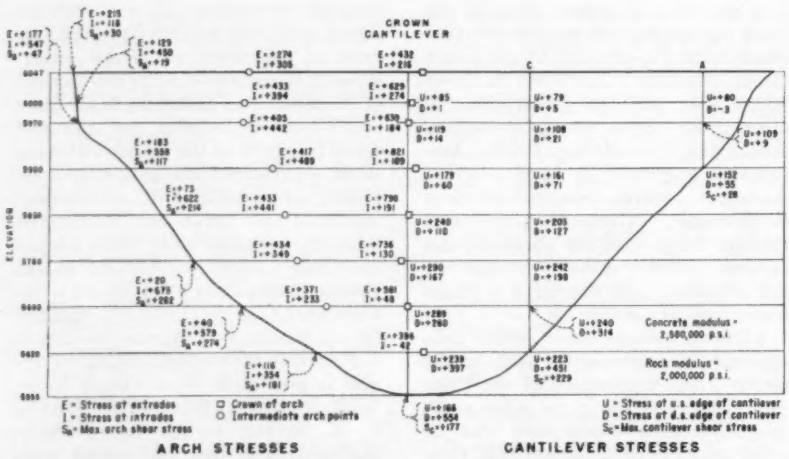

CROWN
CANTILEVER
ELEVATION
E = Stress at extrados
I = Stress at intrados
Ss = Max. arch shear stress
Crown of arch
Intermediate arch points
U = Stress at u.s. edge of cantilever
D = Stress at d.s. edge of cantilever
Ss = Max. cantilever shear stress
Concrete modulus = 2,500,000 p.s.i.
Rock modulus = 2,000,000 p.s.i.
ARCH STRESSES
CANTILEVER STRESSES

FIG. 2. Stresses are computed at critical points on profile on axis looking downstream (developed).

Dam design

Type and layout of the dam were dictated primarily by the topography of the site. The canyon is comparatively narrow at the bottom with steep abutment walls, and this V-shaped configuration is the most desirable for an arch layout. The maximum height of the dam was influenced by the proximity of the town of Green River to the maximum reservoir surface and by the limited size of the rock point that serves as the right abutment of the dam.

The dam was designed by the trial-load method of analysis as a variable-center arch structure. This means that the horizontal arcs forming both the upstream and the downstream faces of the dam are varied in such a way that they provide the most favorable arch properties possible, and at the same time produce sufficient abutment thicknesses to transfer the load safely from the dam to the abutment rock. The shape of the abutment keyways was planned so that the excavation contours would be as nearly normal to the resultant thrusts as possible without excessive rock excavation.

The layout selected was planned to fulfill the above criteria and still present a simplified form that would tend to minimize construction costs. The radius to the axis of the dam is 650 ft; the upstream face, vertical to approximately the mid-height of the dam, has

a constant radius of 590 ft. Above mid-height, the upstream face curves in a downstream direction to meet the axis near the top of the dam. The downstream face is formed by horizontal arcs of varying radii for the height of the dam.

Stress studies for the design of the dam (Fig. 2) were based on the following assumptions and loading conditions:

Reservoir water surface at El. 6040
Earthquake acceleration of 0.1 gravity acting horizontally upstream and downstream in direction of plane of centers
Modulus of elasticity of concrete, 2,500,000 psi
Modulus of elasticity of rock, 2,000,000 psi
Concrete cooled to 38 deg F when contraction joints are grouted
Maximum allowable compressive stress, 1,000 psi

The following maximum computed stresses were obtained:

821 psi arch compressive stress at crown extrados, El. 5900
675 psi arch compressive stress at abutment intrados, El. 5760
818 psi principal stress at abutment downstream face, El. 5760
42 psi tensile stress in arch at crown intrados, El. 5620
282 psi arch abutment shearing stress, El. 5760
554 psi compressive stress at downstream face at base of crown cantilever
3 psi tensile stress at downstream face of cantilever A, El. 6000
229 psi cantilever shearing stress at base of cantilever C, El. 5620

Another trial-load analysis was performed with an assumed rock modulus of 1,000,000 psi to check whether any detrimental stress patterns appeared from the use of the lower modulus. In general, the computed stress patterns were as satisfactory as those obtained using the higher modulus. The arch stresses at the abutment were more evenly divided between the extrados and the intrados. At the crown of the arch the stresses increased somewhat at the extrados with a corresponding decrease at the intrados. For the cantilever elements, the stresses at the upstream face tended to increase, with a corresponding decrease in stress at the downstream face. The following maximum computed stresses were obtained:

891 psi arch compressive stress at crown extrados, El. 5900

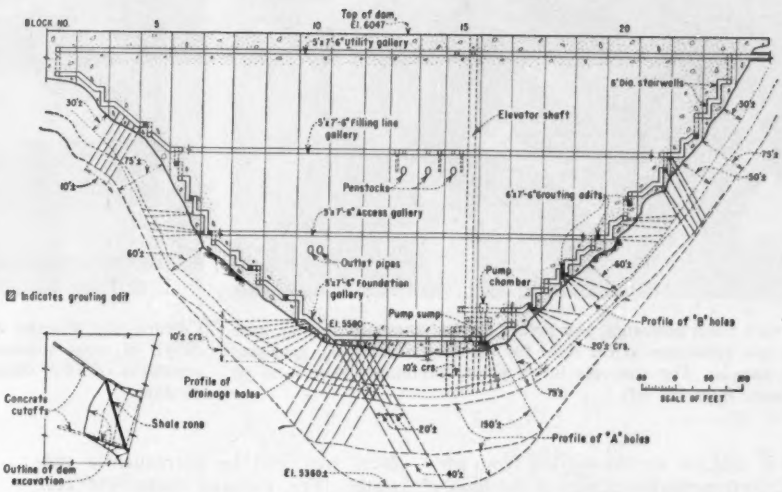


FIG. 3. Most of holes for drainage relief and grouting are drilled from galleries 5 x 7½ ft. Treatment of shale zones is shown in inset at left.

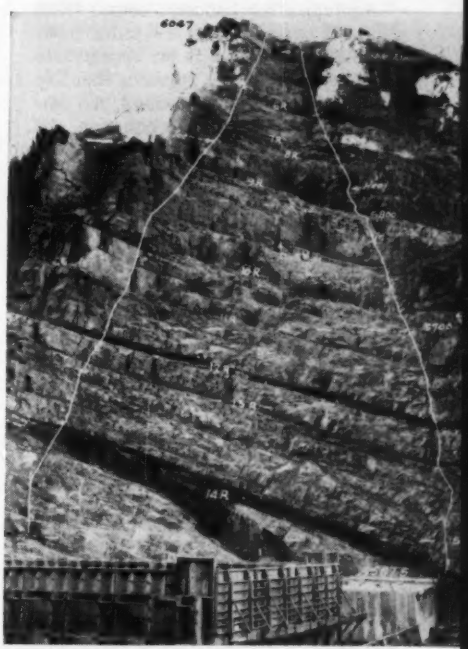
645 psi arch compressive stress at abutment intrados, El. 5840
743 psi principal stress at abutment downstream face, El. 5760
123 psi tensile stress in arch at crown intrados, El. 5620
257 psi arch abutment shearing stress, El. 5760
421 psi compressive stress at downstream face at base of crown cantilever
No tensions at downstrean face of any cantilever sections
217 psi cantilever shearing stress at base of cantilever C, El. 5620

Foundation treatment

Foundations for the dam will require more treatment than was originally contemplated since the predominantly near-vertical jointing systems did not tighten as rapidly with depth as had been anticipated. Also, a greater number of shale-like zones of appreciable thickness were encountered than the diamond drilling indicated. The maximum thickness of some of these zones was as much as 12 ft. See Fig. 3.

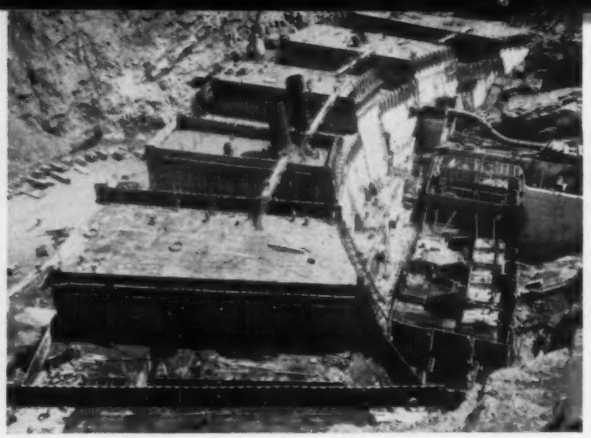
The condition of the jointing in the excavated keyways indicated that the major part of the foundation area should be grouted to obtain proper consolidation rather than only the upstream portion as originally specified. Holes for consolidation grouting are spaced about 20 ft on centers in both directions as originally planned, but the depth has been increased from 25 to 50 ft.

Instead of drilling and grouting from the foundation surface on the steep abutments, the consolidation grouting is being done from a series of transverse adits at about 50-ft intervals in elevation in the gallery system of the dam. Drilling and grouting for the high-pressure grout curtain, as well as drilling of drainage holes, will be performed from the foundation gallery, which follows the foundation near the upstream face of the dam. Tentative plans call for a spacing of



Right abutment keyway for dam is marked. Upstream is to right. Treatment by excavation and backfill concreting of cutoff drifts is planned for shale-like zones 14R, 12R, 9R, 7R, and 6R. Note that zone 14R divides into two zones near the center of the keyway.

In view from upstream, just before start of concrete placing, note the two tailtowers at far right for the 25-ton cableway spanning the canyon. The concrete batch plant, containing four 4-cu yd mixers, is at far left.



Construction progress at the dam, June 15, 1961, when 145,000 cu yd of mass concrete had been placed. Note installation of penstocks of 10-ft diameter and power-plant construction at toe of dam.

10 ft, and for depths varying from up to 200 ft in the lower part of the foundation to 75 ft near the top of the dam.

A drainage curtain of holes 3 in. in diameter will be drilled downstream from the high-pressure grout curtain. These holes, 10 ft on centers, will vary in depth from 60 ft in the lower part of the foundation to 30 ft near the top of the dam. Cutoff drifts 50 to 75 ft in length at the heel and toe of the dam have been completed for shale-like zones of significant thickness on both abutments.

Aggregate and concrete

Aggregate for concrete comes from a gravel deposit about 13 miles from the dam site. There is an appreciable amount of light, flat particles that are generally weak and unsound. To improve the strength of the concrete, the aggregate retained on a No. 8 screen, up to that passing the 1½-in. screen, is processed through a heavy-media separator. The aggregate passes through a vessel containing a water slurry of ferro silicon and magnetite having a specific gravity high enough to float the objectionable lightweight particles. These are floated over a weir and wasted.

The compressive strength specified for the interior mass concrete of the dam is 3,000 psi at an age of 180 days to meet the specification that at 365 days the ratio of compressive strength to maximum stress must be at least 4. Since the maximum stress in the dam is computed at 821 psi, indicated strengths of 4,000 psi from a mix containing about 2 sacks of cement and 1 sack of pozzolan per cu yd seem adequate.

Additional durability is being obtained for the concrete forming the faces of the dam by the use of an enriched layer of concrete from 5 to 10 ft thick. Three sacks of cement plus one sack of pozzolan are used for the faces that will be permanently protected. For exposed faces, the concrete contains at least 3½ sacks of cement, with no pozzolan.

Control of concrete temperature

Mass concrete is artificially cooled to reduce the temperature rise immediately after placement and later to reduce the temperature to the point selected for the closing of contraction joints by grouting. Cooling is effected by pumping cooling water through 1-in. pipe laid on top of each 7½-ft lift at a nominal spacing of 5 ft. To obtain better control of cooling for the initial lift placed directly on the rock foundation, the tubing is laid on the rock at a 2½-ft spacing. On the tops of lifts of which any part is within 15 ft of rock, the spacing is 3½ ft.

River water is used for cooling; no mechanical refrigeration of the water is required. Initial cooling is begun when the first concrete is placed in a lift and continued for 12 days. It is planned to keep the temperature of freshly placed concrete under 60 deg F and subsequently to cool it to 38 deg. This reduction in temperature will be effected during the winter months when the river water is at a low temperature.

In addition to the cooling described above, temperature control for the concrete will require artificial heating of the tops of blocks left exposed during a winter shutdown. This is required to minimize the possibility of cracking at the horizontal construction joint between the new and the old concrete, and to ensure a groutable contraction-joint opening. The tops of the blocks will be warmed by circulating water with a temperature of not more than 100 deg F until the temperature 4 ft below the exposed surface is raised to 50 deg F.

The foundation gallery, laid out to follow the excavated foundations of the dam as closely as practicable, consists of horizontal and inclined runs of gallery and vertical stairwells. Transverse foundation grouting adits are located at about 50-ft intervals in elevation, and as near the foundation as practicable. Longitudinal galleries will provide access to the upstream ends of the penstock and the river outlet pipes, space for compressed-air systems used as ice prevention for structures at the upstream face of the dam, space for electrical control cables extending from the powerplant to the switchyard at the right abutment of the dam, and access for observing structural-behavior installations.

The galleries are rectangular in cross section, usually 5 ft wide and 7½ ft high, the depth of one lift of concrete. All gallery and shaft openings are reinforced for the tensions caused by stresses in the dam. The amounts and locations of these tensions were obtained from photoelastic studies performed on scale models of the various types of openings.

Structural-behavior installations

The dam is being extensively instrumented to determine from the several systems of measurements: stress and temperature conditions in the structure, the opening of contraction joints, and the deflections that will occur in the arch and cantilever elements. To obtain these results, 912 strain meters, 61 stress meters, 31 resistance thermometers and 110 jointmeters are being installed, all embedded in the dam.

Strain meters, embedded in a cluster of 12 instruments at each of several locations, form the major system of instruments from which the three-dimensional conditions of stress are determined. The locations were selected to furnish stress data wherever practicable at points where the theoretical stress was computed by the trial-load method of analysis, so that stresses obtained from each method can be compared.

In addition to the embedded instrument installations, two systems of measurement employing refined methods of surveying are provided for determining the manner in which the dam deflects during periods of reservoir filling. The first system for the measurement of deflections consists of three plumb lines, each in a formed well extending down to near the foundation. Measurements will be made at several points. The second system for determining dam deflections consists of a grid system of 62 targets placed on the downstream face of the dam and 20 targets placed on the foundation along the abutments. Changes in the locations of the targets will be charted periodically from theodolite stations by precise triangulation.

Three lines of uplift pressure pipes with 13 points of measurement will permit the determination of possible uplift pressure from reservoir head.

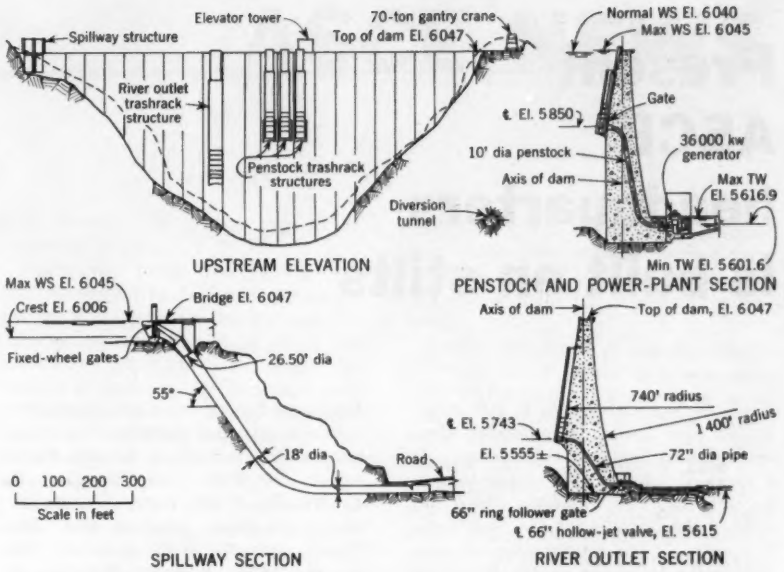


FIG. 4. Elevation and sections of Flaming Gorge Dam, on a tributary of the Colorado.

Spillway and outlet works

To determine the combined capacity of the spillway and outlet works, a maximum flood with a peak discharge of 76,000 cfs and a 15-day volume of 1,084,000 acre-ft was used. By utilizing a 5-ft depth of reservoir above normal high water surface for flood storage, a combined capacity of 32,800 cfs will be required for the spillway and river outlets. Since 4,000 cfs will be the maximum capacity of the river outlets, the spillway was designed for a maximum discharge of 28,800 cfs.

Tunnel size was determined by routing the maximum spillway discharge through an assumed size of tunnel, restricting the depth of flow to 0.8 the depth of the tunnel. The tunnel diameter was fixed at 26.5 ft at the upstream portal, diminishing to 18 ft at the beginning of the elbow and continuing at that size to the tunnel outlet (Fig. 4). The inclined portion of the tunnel was set at 55 deg with the horizontal so that the required diameter would be quickly reduced, and also for ease in removing tunnel muck. A flip bucket will be constructed at the tunnel outlet to arch the discharge well downstream and so produce minimum erosion of riverbed materials. Tunnel discharges will be controlled by two fixed-wheel gates, each 16.75 by 34 ft.

The river outlets (Fig. 4) consist of two pipes of 72-in. diameter extending through the dam. These pipes decrease in size to 66 in. at the toe of the dam, and continue 200 ft downstream beneath the powerplant service area to discharge downstream from the tailrace. Each outlet is protected by a 66-in. ring-follower gate at the toe of the dam. Discharges are controlled by a 66-in. hollow-jet valve at the discharge end of each pipe.

Three penstocks of 10-ft diameter pass through the central part of the dam, each serving a 50,000-hp turbine (Fig. 4). Intakes are 21 ft below the minimum reservoir level and the penstocks are embedded approximately parallel to the downstream face of the dam for a drop of 250 ft to the powerplant. The penstocks are steel lined, except for a short transition at the intake.

Each intake opening is protected by a 8.27 by 15.82-ft fixed-wheel gate suspended just above the intake opening for rapid emergency closure, and operated by a hydraulic hoist located at the crest of the dam. One set of stoplogs is provided for use in inspection and maintenance of the seats and guides for the gates. A gantry crane of 70-ton capacity on the crest of the dam will be used for the installation and removal of the gates, hoists and stoplogs. A trashrack structure protects each intake, with the concrete ribs and columns of the structure adjacent to the intake streamlined for better flow conditions.

Construction status

The climate at Flaming Gorge Dam is typical of high mountain valleys in the Rocky Mountain area. The winters are severe, with frequent below-zero temperatures, so that concrete placement is stopped for about five months each year and other construction activities are handicapped.

Because of the steepness of the abutment slopes, all excavation for the foundations of the dam had to be completed before concrete placement began in the lower reaches of the dam. Excavation for the foundations of the dam and powerplant was completed in the late summer of 1960; placing of concrete was started in September. A concrete batch plant containing four 4-cu yd mixers is located on the left abutment just upstream from the dam. Concrete is placed with 8-cu yd buckets from two cableways, each of 25-ton capacity, operating from a single fixed headtower and two movable tailtowers.

The construction program calls for topping out the dam in the fall of 1962. The diversion tunnel will be closed at that time to store water from the 1963 spring runoff. The first generator is scheduled to be placed in operation in July 1963.

Floyd E. Dominy is Commissioner of the Bureau of Reclamation, in Washington, D. C. Grant Bloodgood, F. ASCE, is Assistant Commissioner and Chief Engineer, in Denver, Colo. L. G. Puls, F. ASCE, is Chief Designing Engineer of the Bureau. Flaming Gorge Dam is in the Bureau's Region 4; F. M. Clinton, F. ASCE, in Salt Lake City, Utah, is Regional Director. J. R. Walton is Project Construction Engineer for the Flaming Gorge Unit at Dutch John, Utah.

(This article is based on Mr. Ford's paper presented at the ASCE Phoenix Convention, before a session of the Power Division.)

Present ASCE headquarters is built on stilts

Early in September ASCE will move to the new United Engineering Center, its third home in this century. As a farewell salute to the present Engineering Societies Building, which has housed the Society for the past forty-five years, "Civil Engineering" is publishing the following article describing its unique structural details. The article, taken from the Society's historical file, has been brought up to date from a manuscript prepared some years ago by Sydney Wilmot, F. ASCE, then Manager of ASCE Publications.

Since 1917 the Headquarters of the Society has been securely perched fifteen stories above New York City streets on four steel columns. Though the interesting features of this addition would escape even the closest inspection, the present Engineering Societies Building, at 33 West 39th Street, was extended upward in an unusual manner to accommodate the offices of the American Society of Civil Engineers.

Previously the Society had been comfortably housed in its own building at 220 West 57th Street which, incidentally, it still owns. So satisfactory were those quarters that little thought was originally given to joining the other Founder Societies in their joint occupancy of the new building. Ten years later, however, the Society decided in favor of a more cooperative attitude.

Thus, a decade after the original thirteen stories of the Engineering Societies Building had been erected with funds generously contributed by Andrew Carnegie, a referendum vote of the membership of the Society directed acceptance of an invitation to join the other three Founder Societies in their new residence. ASCE assumed a large share of the cost of the added stories. In return, it became an equal owner in the whole enlarged property with the three original occupants—the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers.

Construction of the addition was supervised by a building committee of the United Engineering Society (now United Engineering Trustees, Inc.) functioning for the four groups.

One of the basic arguments for the consolidation was the unification of all the libraries. That of the ASCE added materially to what was already available. The result of the pooling of books was to make the library the premier engineering library of America, if not of the world. However, the addition of thousands of volumes to the existing library required another whole floor of storage capacity. In addition, ASCE office facilities demanded two full floors. Therefore a three-story addition on top of the existing thirteen-story building, with elevator and other facilities, was proposed.

Design of the structure presented problems at first considered impossible of solution. Architecturally, the thirteen floors formed a unit that could not well be stretched upward to include a three-story topping of any customary style; structurally the additional weight presented serious difficulties. By bold planning both handi-

Artist's painting shows the front of the United Engineering Center, to which 19 engineering societies will move early in September. The new Center is in a beautiful part of the city, dominated by the United Nations.

caps were overcome in a most acceptable and pleasing manner.

The suggestion of a tower effect through a setback of the walls of the addition did not upset the esthetic proportions of the building. The structural solution favored this setback, which fitted very well into a simplified design. The added mass was held back from the existing ornamentation of the cornice in such manner as to avoid a top-heavy appearance.

Structurally the problem was not so simple. The top floor of the original building was occupied by the library, which had no central columns. Its roof was carried on trusses spanning the large central hall. On the third floor, the large-span main auditorium likewise interrupted any possible column continuity. Obviously, the then existing walls and columns could not carry the additional loading, and it seemed impractical to reinforce the existing framing.

A careful study disclosed that at four points, well spaced on the plan of the floors, additional columns could be run through the entire existing structure to new foundations on rock. According to this plan, a trussed cage was developed to rest on the new columns. The columns were stayed against buckling by connection to floor beams, and in one case to an adjoining column.

Additional wind bracing for the new columns was not included in the design. Wind pressure was carried into the existing structure, built under the old New York City Code, which demanded a much thicker masonry wall to withstand wind loading than that later required. Wind stress on the new floors was also carried into the masonry walls.

Perched on top of the four new columns, trusses were erected directly below the fifteenth floor to carry the framing of the new floors. The fourteenth floor, which formed a new stack room for the library, was suspended from the bottom chord of these trusses. It was necessary to arrange diagonals of the trusses in such a manner as would permit openings from one part of the stacks into the others. Short central panels without diagonals serve very well in this capacity.

Floors were of reinforced concrete with the exception of the fourteenth which, because of the close clearance with the library ceiling, was constructed of book tile on structural tees with a cement floor finish. To serve the new floors, elevator shafts were extended upward and new machines installed. In effect, the remodeled building, which outwardly presents a harmonious whole, is really two virtually independent but interlaced structures.

Under the terms of the agreement by which ASCE joined its fellow societies, it was to have its choice of location in the rebuilt structure. After some study, it decided to move into the new part of the building. Thus the fifteenth floor was laid out as headquarters, with a Reading Room, Board Room, and private and general offices. The sixteenth floor was taken over in part for special uses; with increased space demands the Society later needed to use the entire floor, which now for years has been occupied by editorial, advertising, drafting, and mailing departments.

Today, with ever-increasing memberships, the four Founder Societies have long been cramped for space in which to function efficiently. Fortunately the conflicting opinions and emotions that once kept ASCE from joining its fellow engineering societies in a bold new building venture no longer prevail. Today unity and cooperation, as symbolized in the new United Engineering Center, are recognized as essential to the future of the profession.

Typical street scene in front of the present Engineering Societies Building, on 39th Street, home of ASCE for almost half a century. The garment district has grown up around the old building.

This building, on 57th Street, housed the Society from its formal opening on November 24, 1897, until 1917.

Need for water research shown in Fort Collins symposium

Objective and scope of the recent Symposium on Basic Research in Civil Engineering Fields Related to Water Resources, were brought into sharp focus by several articulate keynoters. These, and some 75 other informed persons, gathered in Fort Collins, Colo., June 12-15, at the invitation of three sponsoring organizations: Colorado State University, the U.S. Bureau of Reclamation, and the American Society of Civil Engineers. These selected participants, through their collective wealth of experience, covered the fields of technique involved in development and utilization of water resources.

Orienting the participants, Alfred R. Golze traced the development of the symposium. Mr. Golze, former Assistant Commissioner of the Bureau of Reclamation and now chief engineer of the California Department of Water Resources, is credited with proposing the conference, and energetically pursuing the early stages of organization.

Mr. Golze explained that, "Because of our great concern with maintaining and advancing the ability of the civil engineer to solve tomorrow's problems today, a group of interested engineers, all members of ASCE, decided it was time to work out a practical approach. So in August 1960, a planning committee was jointly appointed by Colorado State University, the Bureau of Reclamation, and ASCE to investigate means of stimulating research in the fields of civil engineering. "If we are going to build the great projects of tomorrow, needed to serve all these millions of people, we are going to need to know a lot more than we think we know today," he said. "That is one good reason why you are all gathered here today."

Mr. Golze also noted that, "In Fiscal Year 1962, which begins in July, in excess of $100 million will be spent on research-type projects by the Department of the Interior. Less than $1 million of this amount will be spent on identifiable civil engineering research, even though more than 40 percent of the total $765 million budget of the department will be spent by the Bureau of Reclamation alone in the design and construction of projects which are primarily of a civil engineering nature."

The strong interest of ASCE in the unique research program was expressed by one of its two representatives on the planning committee—Col. Edmund H. Lang, director of the U.S. Waterways Experiment Station at Vicksburg, Miss. The other representative on the committee was Gerald T. McCarthy, New York consulting engineer. Said Colonel Lang, "We need understanding on the part of the public, of their representatives charged with making decisions, and even on the part of industry, of the worthiness of research which will nurture civil engineering.

"This Symposium can make a major contribution in developing support for needed civil engineering research. Those here as participants are authorities in technology needed to develop water resources, but realize the inadequacy of our knowledge far better than most. What we know are secrets wrested from a reluctant and a mysterious nature which appears to grant man only enough insight to keep his interest aroused. . . .

"The American Society of Civil Engineers welcomes the opportunity to lend its name to the sponsorship of this program and hopes that from it will emerge the support needed to get under way civil engineering research that must be undertaken for our nation to occupy its rightful place in the future."

Strong support for the drive to advance research was offered by Commissioner of Reclamation Floyd E. Dominy, who described eloquently the reasons for his support as he addressed the Symposium. Said Mr. Dominy, "The civil engineer has a prime responsibility in seeing that our priceless water supply is conserved and utilized to the maximum degree possible. He must find new ways of increasing our supply through control of the weather and by producing potable water from brackish water and the sea. He must find economical ways of reducing losses from reservoir evaporation and losses in conveyance channels. . . .

"One of the most important phases of research and development confronting the civil engineer, and a problem of serious concern to the Bureau of Reclamation, falls outside of the laboratory. That phase is the coordination, abstracting, reviewing, and dissemination of the results of engineering research.

"New methods, new tools, and new materials are of vital concern to the civil engineer . . . An engineer ten years out of school is apt to be an obsolete old mossback, unless he spends at least 30 percent of his working time reading and studying current technical literature . . . Scientific research now leads engineering research by a wide margin, and engineering research leads the practicing engineer by time gaps that are far too large. This is more than a short 'missile gap'; it is a broad abyss that must be bridged by a structure of new design.

"Somehow," Commissioner Dominy continued, "we must quickly establish better communication and simplify the job the practicing engineer faces in utilizing the results of research. Since much of this research and development occurs in Europe, the barriers of language, distance, units of measurement, and terminology must be overcome. We must capitalize on world-wide engineering knowledge. This can best be done through a centralized abstracting and publishing service for civil engineers, through study tours, through exchanges of specialists, and through international engineering organizations."

Panels list research needs

Conference participants, through panel study, produced listings of specific research programs meriting priority of attention. Such projects will be listed in the proceedings of the symposium. Categories covered were:

Static and Dynamic Behavior of Soils
Static and Dynamic Behavior of Rock
Static and Dynamic Behavior of Concrete
Fluvial Hydraulics
Hydraulics of Water Conveyances
Flow in Porous Media
Conservation and Utilization of Water

Common to all these programs was the expressed need for correlation of laboratory findings with field experience.

Costs returned in savings

Pointed comparison was made with certain other major research efforts, emphasizing that research supporting civil engineering would ultimately pay for itself in construction and operation savings, as well as increased service to the public. One example was the prospect of a 40 percent saving on water sent through distribution canals, if enough were known about effective canal linings and evaporative barriers.

Costs for urgently needed research can profitably be $9 million per year, about 1½ percent of the total construction costs of public works. This

Symposium on Research in Water Resources was organized and conducted by a planning committee composed of representatives of the three cooperating organizations. Left to right, they are Col. Edmund Lang, representing ASCE; Walter H. Price, general chairman and U.S.B.R. representative; Norman A. Evans, Colorado State University representative; John Lowe III, alternate for Gerald T. McCarthy, ASCE representative; James W. Ball, U.S.B.R. representative; and A. R. Chamberlain, Colorado State University representative.

Panel chairmen for Research Symposium on Water Resources seen, in usual order, were: John W. Vandervelt, President of Colorado School of Mines; Walter H. Price, general chairman; Douglas McHenry, Portland Cement Association; Dean F. Peterson, Utah State University; Harvey O. Banks, Leeds, Hill, Jewett, consulting engineers; Ralph E. Fadum, North Carolina State University, and chairman of ASCE Research Committee; Arthur T. Ippen, Massachusetts Institute of Technology; and John S. McNown, University of Kansas.

would mean about a six-fold increase over current research levels.

The location of the conference may have had something to do with the construction consciousness of the participants. New construction was everywhere apparent on the Colorado State University campus, and was pointed to by the university's energetic president, W. E. Morgan, as he served as host. A. R. Chamberlain, A.M. ASCE, was the university representative on the steering committee, and Norman A. Evans was chairman of the excellent local arrangements.

Tellers Canvass Ballot For 1962 Officers

New York, N. Y.
June 30, 1961

To The Secretary
American Society of Civil Engineers:

The Tellers appointed to count the Ballot for Official Nominees report as follows:

For Vice President—Zone I
(Term October 1961-October 1963)

Carey H. Brown	454
*Thomas J. Fratar	42
Scattering	268
†Ineligible Candidate	61
Void	0
Blank	36
Total	861

For Vice President—Zone IV
(Term October 1961-October 1963)

Burton G. Dwyre	1,211
*Fred H. Rhodes, Jr.	86
Scattering	420
†Ineligible Candidate	63
Void	4
Blank	63
Total	1,847

For Director—District 1
(Term October 1961-October 1964)

David G. Baillie, Jr.	204
Scattering	124
†Ineligible Candidate	59
Void	0
Blank	24
Total	411

For Director—District 3
(Term October 1961-October 1964)

N. A. Christensen	121
Scattering	27
†Ineligible Candidate	30
Void	1
Blank	8
Total	187

For Director—District 5
(Term October 1961-October 1964)

W. Orme Hiltabidle	136
Waldo E. Smith	119
Scattering	44
†Ineligible Candidate	53
Void	0
Blank	4
Total	356

For Director—District 7
(Term October 1961-October 1964)

Charles W. Yoder	415
Scattering	21
†Ineligible Candidate	60
Void	0
Blank	2
Total	498

For Director—District 11
(Term October 1961-October 1964)

Henderson E. McGee	792
Scattering	141
†Ineligible Candidate	103
Void	5
Blank	16
Total	1,057

For Director—District 12
(Term October 1961-October 1964)

Leland J. Walker	423
Scattering	39
†Ineligible Candidate	23
Void	0
Blank	0
Total	485

For Director—District 16
(Term October 1961-October 1964)

Roy M. Green	556
Scattering	31
†Ineligible Candidate	43
Void	0
Blank	2
Total	632

Total number of ballots counted	6,334
Ballot envelopes without signature	9
Dues arrears	12

Respectfully submitted,
Richard D. Egazarian
Chairman
John D. Stallman
Vice Chairman
Albert P. Loriot
Philip Perdichizzi
Ralph M. Baumgarten
William H. Gerstle, Jr.
Charles W. Griffin, Jr.
Tellers

* Withdrawn at nominee's request.
† These votes were cast for incumbent officers who are presently ineligible for re-election in accordance with Section 9, Article VI, of the Constitution.

(More ASCE News on Page 68.)

Experimental transmission tower of prestressed concrete

MORRIS SCHUPACK, F. ASCE, Partner, and **ALEX McDONALD,** Designer, Schupack and Zollman, Consulting Engineers, Stamford, Conn.

A prestressed concrete tower 100 ft high was built as part of the experimental extra-high-voltage transmission line recently constructed by the General Electric Company. The tower is made up of three main members 18 x 36 in., two uprights and a cross arm with hollow cross-section. See Fig. 1. The tower was precast and members with a maximum length of 94 ft and a maximum weight of 22 tons were shipped 135 miles to the site.

The cross bracing consists of 12 x 12-in. solid prestressed concrete sections joined both at the intersection point and at uprights by steel details. The safety ladder, hand-rails and other miscellaneous ironwork are attached directly to the precast members by means of inserts. All steelwork is metalized for corrosion protection. The foundation for the tower is founded on piles and the uprights are secured into a socketed footing.

This structure is believed to be the largest precast concrete tower constructed to date. It indicates some of the potential structural capabilities of prestressed concrete.

This tower is one of many types utilized on the experimental Extra-High-Voltage (EHV) Project at Pittsfield, Mass., a cooperative effort of many public utility companies and several of the electric supply companies in the United States and Canada. Transmitting power more economically at higher voltages (up to 750 kv) is being investigated in this project with regard to both the electrical aspects and the structural aspects.

Design considerations

Loadings are shown in Table I. Other design considerations that affected the shape and the form of this tower were:

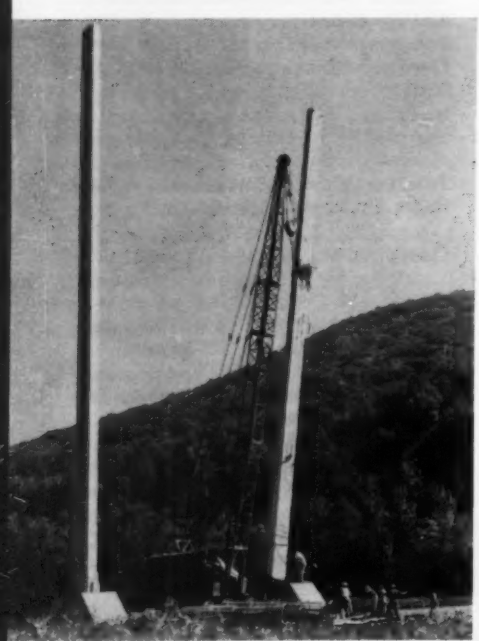
1. Shipping limitations of about 25 tons in weight and 100 ft in length.
2. Foundation conditions, which resulted in a footing on piles extending 5 ft above the ground.
3. Fabrication facilities, which made available 36-in. box beam forms and 12-in.-square pile forms.

This tower, which was donated to the EHV Project by the Prestressed Concrete Institute, was conceived on a relatively small budget. It had to be designed for fabrication to meet the particular experimental needs. Forms available at Blakeslee Prestress in Hamden, Conn., fit well into the design requirements, and the details were conceived to fully utilize the available facilities.

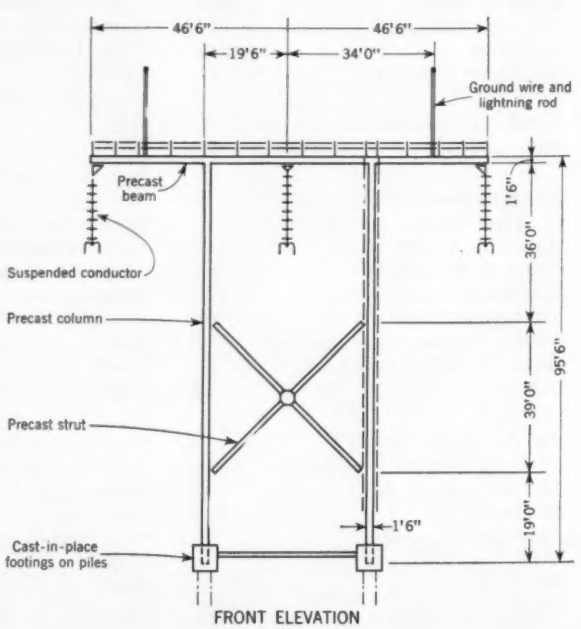
The main purpose of this experimental tower was to determine the structural applicability and the electrical properties of prestressed concrete. It was not the purpose at this time to develop an optimum design for, say, a project that would include 50 or 100 towers.

The prescribed loadings (Table I) were ultimate loadings. No working loads were specified. The designers assumed a reasonable working load to assure the proper performance of the structure under service conditions. This is done to assure that under normal working loads, cracking will not occur, which may be detrimental to the long life of the structure.

The design for the above loading followed, in general, the recommendations of the joint Committee on Pre-



◀ **Column 100 ft long, of hollow box section, is set in footing socket after being transported to the site by truck. When first erected, columns were temporarily wedged in place with hardwood wedges.**



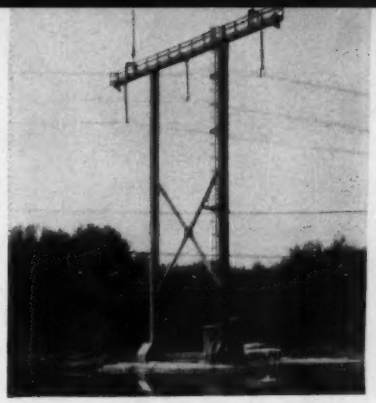
▶ **FIG. 1. Both uprights and cross arm for experimental extra-high-voltage tower consist of precast 18 x 36-in. hollow prestressed concrete sections 93 ft long.**

TABLE I. Governing ultimate loads for EHV tower

Item	Beam Design Loads	Upright Design	
		Transverse loading†	Longitudinal loading†
Conductor load:*			
Vertical, kips 25		7.9	0
Horizontal, kips 5.4		7.7	0
Dead load factor .... 1.20 D.L. + 40 psf		1.25 D.L.	1.10 D.L.
Wind load, psf 0		42	63

*Conductor loads, shown in kips (1,000 lb), are applied at each of three conductor locations.

†Transverse and longitudinal loadings do not occur simultaneously.



Experience in erecting this tower led to the conclusion that a second tower of the same type could have been put up in two or three days.

stressed Reinforced Concrete, of ASCE and the American Concrete Institute.

In checking the stability, comparatively little information was found in the available literature. However it was determined that in the case of the uprights of this tower, the applied ultimate loads produced plastic deflections of predictable magnitude but were still below the ultimate strength of the members. Consequently, secondary bending, brought on by the loads applied to the deflected structure, could be determined. The primary and secondary bending (and incidentally, tertiary bending) all produced moments below the ultimate strengths of the members. It was concluded, therefore, that the tower was stable in its deflected state. That is, buckling—increase in lateral deflection without any increase in load—would not occur, as described by Broms and Viest in the Journal of the ASCE Structural Division for January 1958.

To determine the ultimate resisting strength of the members with supplemental non-prestressed high-strength steel, a strain analysis of the reinforcing steel was resorted to. By determining the extent of the flexural strains during ultimate loading, final steel strains could thus be determined. That is, the prestressed-steel strain equaled the effective strain after prestressing losses plus the flexural strain during loading, while the non-prestressed steel strain equaled the flexural strain during loading. Using these data and the stress-strain curves of the steels, the degree of participation of each of the steels was determined. The use of the typical stress-strain curves was required because the stresses in these ranges were not proportional to the strains.

Other design aspects of this structure included its electrical characteristics and the substructure. The former were investigated experimentally by J. J. LaForest of the General Electric Company. The substructure was designed by E. Haslam under the direction of S. Alpert of Stone and Webster Engineering Corporation, the general consultants.

A 100-ft column length was well suited to the tower dimensions, and the rectangular, hollow-box concrete sections provided columns that could resist bending in any direction as well as torsion. With the hollow section, tensioned strands were located on top of as well as below the void form (Fig. 2). Thus the void form had to be placed before concreting. It was anticipated that the placing of high-strength concrete down the sides and under the void might prove difficult. This was especially so as the specified slump of the concrete was 1½ to 2 in. The fabricator elected to use both internal and external vibrators and to check constantly that a head of concrete was surging along the soffit in advance of the web and top concrete. Results were excellent as was indicated by a total absence of camber under uniform axial prestress.

Erection procedure

The erectors were experienced in the field of steel tower erection, and initially they were unfamiliar with, and dubious of, precast concrete. Once they became familiar with the handling of precast concrete units the erection of the tower proceeded without difficulty. At the end of the job the consensus was that a second tower could be erected in only two or three days.

The procedure consisted of setting the columns in the footing sockets and temporarily wedging them in place with hard-wood wedges. Next the X-bracing was attached to the columns by means of turned pins through steel inserts set in both column and brace. After plumbing, the center connection was welded. For this purpose, dowels were provided from each of the four braces, all to be welded to a connecting plate.

The cross-beam was then lifted by two cranes and set over anchor bolts, onto an impregnated canvas pad. Slotted holes 4 x 2 in. had been provided in the beam to receive these bolts. The slotted holes provided more than ample tolerance for erection. After the completion of the joinery of the tower, the footing sockets were dry packed and the wedges removed. Next the steel appurtenances were bolted into concrete inserts, previously set to receive them. Finally, the center connection of the X-bracing was encased in concrete.

Conclusions valuable

In building this EHV tower, much was learned as to the possibility of utilizing the concepts of prestressing in concrete tower work. There is no doubt that in certain areas and under certain conditions prestressed concrete would make an economical, esthetic and low-maintenance tower structure. In designing a prestressed concrete tower, it is necessary to work closely with the electrical engineer in the early stages of his planning to determine the best means of stringing the cables. In this way the configuration of the tower could be worked out to integrate the best positioning of the cables with the best use of prestressed concrete. It may be found that, by utilizing prestressed concrete in combination with other materials, the most economical and functional structure would result.

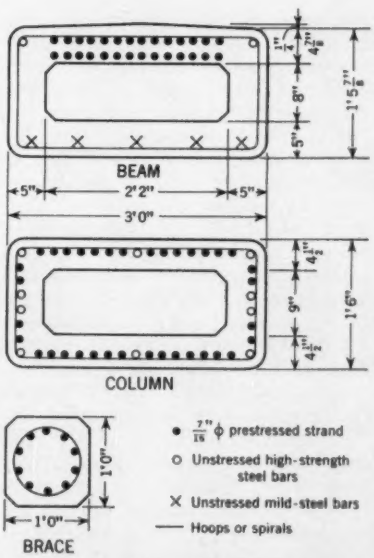


FIG. 2. Cross-sections of tower members show nature and location of prestressing and reinforcing steel.

Uses of radioisotopes in civil engineering

J. S. MARCUS, M. ASCE, Professor, Department of Civil Engineering, University of Massachusetts, Amherst, Mass.

Radioactive isotopes represent a new tool whose uses in the field of civil engineering have only just begun to be appreciated. Many commercial instruments have already been developed which can perform jobs more efficiently than is possible with standard techniques. In the civil engineering field, uses of radioisotopes include the determination of leaks in underground piping, the measurement of soil density and moisture content, and the measurement of rate of liquid flow.

The development of radioisotopes has been of tremendous economic significance in the industrial world. The rise of isotope technology has come about as a consequence of the development of the nuclear reactor, and because of the many advantages inherent in isotope use, may prove to be of greater value to industry and society than the reactor itself. A summary of the industrial uses of isotopes is given in Table I. Their use is continuing to increase annually.

The Atomic Energy Commission estimates that savings in material, labor, maintenance, and down time due to the use of isotopes run as high as $500 million per year. A report prepared by the National Industrial Conference Board for the Commission in mid 1959 included the following case examples. One paper company was saving over $193,000 annually through the use of beta gages at an annual cost of slightly more than $10,000. A manufacturer of pressure vessels, boilers, etc., was able to do the needed radiographic work with artificial isotopes at an annual saving of $100,000 over what the work would have cost using X-ray machines and radium. A large petroleum company, through the use of catalyst circulation meters representing an annual cost of $2,400, was able to produce $2 million worth more of gasoline annually with no increase in production costs.

A number of uses for isotopes in civil engineering and allied areas have already been developed. In fact, instrumentation is already commercially available to perform a variety of jobs. A broader understanding of potential isotope uses would increase their applicability in many other areas. This does not in any way imply that isotopes represent the solution to all the unsolved problems of the profession, but their wider use would be most beneficial in many cases.

A brief review of the characteristics of radioactivity is presented here, along with some definitions of terms to be used later.

Isotopes are atomic species whose masses differ even though they belong to the same element and have the same atomic number and chemical properties.

A nuclide is an atomic species characterized by the constitution of its nucleus.

Radioactivity is a process whereby certain nuclides undergo spontaneous disintegration during which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation, such as alpha particles, gamma photons, etc. Radioactivity may be either natural—exhibited by more than fifty naturally occurring nuclides—or artificial—produced in a substance after bombardment with neutrons or other particles.

A neutron is a basic nuclear particle.

An alpha particle is a helium nucleus consisting of two neutrons and two protons, emitted usually from heavier nuclei.

A beta particle is an electron, originating in and ejected by a nucleus. Usually we deal with negative electrons although positive electrons are also emitted.

A gamma ray is an electromagnetic radiation of nuclear origin frequently accompanying other kinds of nuclear emission.

Table II gives some of the properties associated with various nuclear emissions.

Detection instruments of many types are available but his article will not attempt to define them.

Availability of radioisotopes

The availability of practically all isotopes has increased tremendously, and in many cases outstrips the demand. This availability is reflected in the very sharp downward trend in the price of such commonly used isotopes as carbon-14 and krypton-85.

Isotopes are commonly produced by one of three techniques:

1. Bombardment in reactors. Such commonly used isotopes as iodine-131, cobalt-60, carbon-14, and tritium (hydrogen-3) are produced by bombardment with neutrons in nuclear reactors.

2. Recovery of fuel-element fission products. Krypton-85, strontium-90, and cesium-137 are examples of widely used beta emitters that are extracted from the fission products found in fuel elements. These fission products represent a tremendous source of isotopes.

3. Bombardment by accelerator-energized particles. A limited number of isotopes are produced by bombardment of materials with high-energy particles from particle accelerators.

Each use requires a radioactive substance having the proper characteristics to solve the specific problem, and today there are enough types available to suit almost any need. Much of the supply is available through commercial distributors, and special needs can be satisfied directly through the Atomic Energy Commission. There are many research reactors in opera-

tion throughout the country, and frequently an isotope can be prepared to order in one of these facilities.

Methods of use

Radioisotopes are used in a variety of ways which can be summarized as follows:

1. As tracers where the radiation is used because it can be detected at a distance from the isotope and through materials.
2. For the power available during the decay of the isotope.
3. For the ability of the radiation to produce physical and chemical changes.

Although all three of these types of use have definite engineering significance, only the first type will be discussed here. In the following discussion of four actual case studies, the emphasis is on civil engineering applications.

To find leaks in underground piping

A technique used to find leaks in buried industrial piping is discussed by R. E. Black and W. Kerwick in *Nucleonics* (vol. 18, no. 8, 1960). In brief, the method involves the sealing of a radioactive source into a sealed float, which is weighted so that it has the same density as the fluid in the pipe system. The system is filled with liquid and then sealed off with the float enclosed. Since any current will then be only through areas where there are leaks, the float will be attracted to such areas. Its position can be determined by a proper detector through as much as 18 in. of backfill or 9 in. of concrete. Because of the great depth of material through which radiation must be detected, an appropriate gamma-ray emitter must be used. In one case as many as six leaks in the same line were found and confirmed.

PHOTO 1. A surface moisture probe is seen in use "on site." Operator is holding the probe over the test surface. Reading device is in the box in front of him. Nuclear Chicago Corporation photo.

TABLE I. Industrial organizations that use radioisotopes, 1946-1958*

Types of Organizations	No. of Organizations
Research, development, testing	209
Electrical equipment, electronics, instrumentation	157
Metal working	144
Paper, plastics	115
Chemicals	95
Manufacturing (other than indicated)	81
Petroleum and allied uses	80
Machinery	74
Food, agriculture	51
Rubber	45
Piping, valves, tanks	39
Aircraft	30
Building materials	28
Pharmaceuticals, medical supplies	29
Engineering, construction	28
Textiles, leather	24
Mining	19
Communications	14
Automotive	11
Glass, tile, concrete	12
Railroads and allied fields	12
Utilities	11
Optical, photography	9
Printing, publishing	9
Marine	7
Abrasives	7
Tobacco	6
Other	14
Unidentified (not listed in standard industrial indices)	142
Total	1,502

* From the "The Atomic Industry, 1958", *Atomic Industrial Forum.*

To measure soil density and moisture

A standard field technique for the measurement of soil density and moisture content involves the use of instruments containing appropriate emitters. Such instruments are already on the market. (See "Measurement of Moisture and Density in Soils by the Nuclear Method," by J. L. Kuranz, ASTM Symposium, Oct. 1959.)

The moisture measuring devices depend on the moderation (slowing down) of the fast (high-energy) neutrons emitted by several types of available emitters. The slowed-down neutrons are detected by appropriate detectors, which can differentiate between fast and slow neutrons. Water is a good slowing-down medium (see Table II) and thus increased activity measured at the detector indicates increased moisture content. See Fig. 1 and Photo 1.

Devices for measuring soil density take advantage of the attenuation of gamma rays by dense materials. Thus denser soils will absorb more activity than less dense soils. The principle behind the use of these devices is essentially the same as that shown in Fig. 1, with the primary difference that the emitter is a gamma ray emitter rather than a neutron emitter. The back-

TABLE II. Properties of nuclear radiations

Radiation	Electric Charge	Mass (amu)	Penetrative Ability	Remarks
Alpha particle	+2	4	Very low	.....
Beta particle	−1	Very small	Low	.....
Gamma ray	0	0	High	.....
Fast neutron	0	1	High	Are readily converted to slow neutrons by light materials—water, graphite, paraffin, etc.
Slow neutron	0	1	....	Has varying probability of interaction but is stopped readily by a number of materials

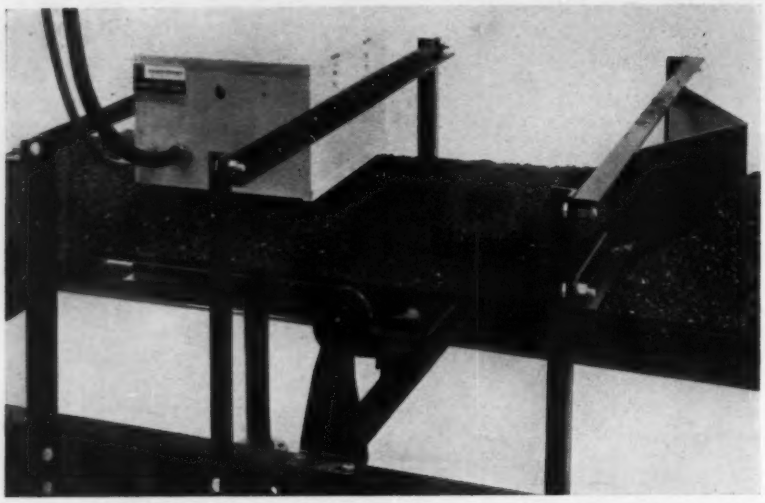


PHOTO 2. Bulk density gage is mounted on a conveyor belt to measure and control the bulk density of solid aggregate. Nuclear Chicago Corporation photo.

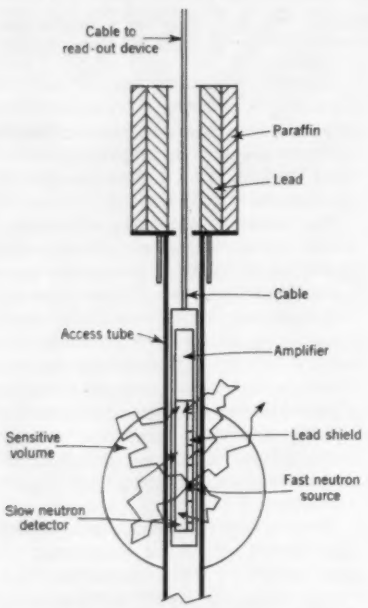


FIG. 1. Depth-moisture gage (in schematic sketch) is based on principle that fast neutrons leaving source are slowed by surroundings. Only slow neutrons are counted by the detector.

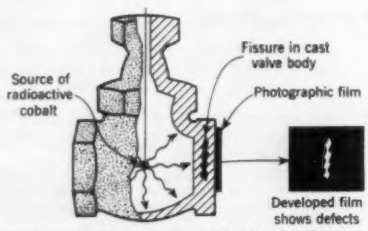


FIG. 2. Radioactive cobalt (Co 60) is used for radiographic testing of a cast valve body.

scattering concept is, however, as valid for gamma rays as for neutrons.

This same principle can be utilized to measure the bulk density of materials as shown in Photo 2. Here the measuring head is placed directly above the conveyor belt while the recorder-controller may be located at a distance.

These isotope techniques offer the following advantages:

1. Large samples can be measured without disturbing the soil.
2. Simple, rapid, and reliable measurements can be made in the field.
3. The accuracy is equal to or better than that obtained by conventional techniques.
4. Measurements can be made over a long period in order to determine variations with time.

For tracer measurements

The salt-velocity technique for measuring the rate of water flow has been known and used for a number of years. The same technique can be used with isotopes and offers the advantage that measurements can be taken without any penetration of the system. Thus tracers can be injected into pipelines that carry liquids of different densities at the interfaces between the liquids. The interfaces can then be detected at long distances from the injection point.

Similar projects have involved the injection of appropriate isotopes into streams in order to determine rates and directions of flow. Naturally due regard must be paid to safety measures but the choice of isotopes is a large one and each experiment can be designed to suit the conditions.

An area of industrial work that has benefited considerably from the advent of radioisotopes is radiography. Radioactive sources are supplementing X-ray machines and are making possible inspections that are uneconomic or impossible by X-ray. Isotopes can be readily transported to field sites and used in locations that X-ray devices simply cannot reach, as shown in Fig. 2. Here a fissure in a cast valve body is found by the use of radioactive cobalt. There are four obvious advantages in this method: (1) versatile and reliable inspection, (2) inspection without dismantling, (3) sources of desired shape and size, and (4) sources of very high activity available at low cost.

A rather interesting use of autoradiography has been reported in connection with some work done in electroplating thicknesses. A radioactive isotope was added to the plating solution. The plated material was then covered with photographic plates which, when developed, showed differences in darkening that could be correlated with the thickness of the material deposited.

Hundreds of other examples could be cited but the above have been given to indicate the versatility of this new tool and to suggest areas in the civil engineering field where additional uses may be found. Isotopes have any number of research applications and have been used for wear testing, in liquid-level gages, in illuminated markers, and for many other purposes too numerous to list here.

Licensing and safety

The use of radioactivity requires personnel that have an understanding of how this tool can be properly used. This, in effect, makes it no different from most other tools. Because, however, its improper use may cause harm to others beside the user, a license for isotope use is required by the Atomic Energy Commission for amounts of material above certain prescribed limits. In a number of areas, short courses are offered in isotope handling and use, and successful completion of such a training program will normally provide qualification for a license. The AEC conducts inspections of licensed facilities in order to insure that licensees conduct their programs with due regard to the rules for health and safety.

Radioisotopes possess properties that make them amenable to research and testing methods in ways heretofore impossible. Isotopes have proven themselves capable of yielding savings in many areas and certainly their use in civil engineering promises similar benefits.

Offshore oil-well drilling structures

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Offshore oil-well drilling platforms are particularly interesting from a structural standpoint because they are highly specialized. Their design and construction present difficult problems of stability and of resistance to wind, wave, earthquake, corrosion and enormous and varying loads. And they are located at the jumping-off place at the edge of the ocean deeps.

This article is necessarily general because consultants for this highly competitive industry are usually pledged to secrecy. The field is wide open for ingenuity, however, because there are no restrictive specifications—except overall economy of investment. In the highly competitive oil business this sometimes means getting there first with anything that will work.

Types of structures

Offshore platforms range in type from artificial islands to barges. Most of them are used for exploration, drilling, and production of gas and oil, but they have been used for other purposes such as exploring underwater coal deposits and laying a sewer outfall. It is hard to find two structures alike, although hundreds are scattered throughout the world—in Southern California, the Gulf of Mexico, the Great Lakes, England, the Persian Gulf and Lake Maracaibo.

An example of the permanent type is Rincon Island off the coast of Southern California, a man-made island complete with palm trees. The chief reason an island was built in this case is that at the time the project was started the laws of California allowed offshore operations only from "solid man-made islands of natural materials." Other reasons include fire resistance, a large working area, and low maintenance costs.

In contrast with Rincon Island, Pacific Driller No. 1 exemplifies the mobile type of rig. It is a barge 100 x 200 ft, equipped for drilling. At a site it extends eight legs to the bottom and pulls itself up its legs to operating level. The legs are steel tubes 6 ft in diameter, and the weight of the barge and equipment lifted is 4,000 tons.

The more common offshore systems consist of a platform of one or more decks on a substructure firmly founded on the sea bottom, and for these, erection problems and local conditions determine the type.

Erection may be simple in concept. If there are facilities nearby for fabrication and construction, the substructure may be floated out to the site in one piece, and the deck may be lifted onto the base by a derrick. If a rig is to be built in a remote foreign spot, the structure may have to be transported in small subassemblies by ship or barge and put together with light construction equipment. In such a case, erection problems may overshadow all others.

Local conditions vary. Shallow water calls for many small piles, deep water for a few large columns with a more or less elaborate bracing system. Wave forces may govern the design in one area, wind in another, and earthquake in still another. Each locality has its own peculiar conditions. It is possible to standardize the design only in an area that has proved to be bulging with oil, where many structures will be built.

Of course the primary consideration in the whole undertaking is cost. The proposed scheme must be competitive with the client's other sources of oil. The engineer must produce the cheapest possible structure; if he does not, the cost of the rig may spoil plans that would otherwise be economically advantageous.

Preliminary design

One of the peculiarities of offshore work is that when the designer is first confronted by the site there is nothing to see but water. The client wants to know quickly how much it will cost to provide a stable base for drilling machinery. The engineer may have to scout the area himself and find out what he can about the nature of the bottom—perhaps obtaining clues from geological observations on shore; the seismic history of the region; the corrosive properties of the environment; the availability of local labor, materials, and construction facilities; and such special difficulties as local rules and regulations. Then the engineer may have to call on marine and earthquake consultants if wind, wave, or seismic conditions are obviously critical.

For preliminary planning, some questions can be tentatively settled right away: the assumed depth of water; the number of wells to be drilled from the platform; the size of the rig, ranging from a large layout complete with crew's quarters and a landing place for helicopters, to a minimum tower for drilling only; the life of the structure, a permanent platform or one to be used briefly for drilling and then dismantled.

Drilling equipment and machinery

The engineer must be on the lookout for ways of cutting costs. Fabrication in a foreign country near the site might bring savings not only in fabrication but in reduced transportation cost and insurance exposure. Construction equipment too expensive to be brought in for this one project might happen to be at work in a nearby area. Perhaps this project can be scheduled so as to borrow or take over the equipment at a much reduced rate. Thus the engineer is engaged in accumulating a great deal of information, much of it outside the usual field of dry-land structural engineering.

Since many civil engineers are not familiar with oil-well drilling, a brief description of the process may be helpful in clarifying the function of the structure and the loads imposed upon it. In drilling, a deep hole is made and lined with a steel casing cemented in. A smaller pipe is put down inside the casing through which the oil will be pumped out. The drill is a steel tube pieced together out of short lengths of about 30 ft, with the appropriate cutting tool attached at the bottom. The

The Offshore Co. photo

Drill rig designed for operation over soft bottom, in shallow water. A submerged barge rests on the bottom and carries the drilling superstructure on pipe framing about 50 ft high. The large, retractable pipe serve merely as spuds to maintain position. For moving, the submerged barge is pumped out and raised to the surface.

upper end of the drill pipe is gripped and turned by a so-called rotary machine located on the main deck.

A tower and hoist are provided for lifting. The hoist takes the weight of the drill; through control of the hoist the drilling chief maintains the proper pressure of the tool on the cut face. When a tool has to be changed, the pipe is lifted out as far as possible and wedged tight in the rotary table. A joint is uncoupled at the table and the piece taken off is set back against the side of the derrick. Then the hook picks up the pipe at the rotary and pulls up another length to be removed. To save time, only every third or fourth pipe joint is uncoupled so that the lengths set aside stand 100 ft or so high—hence the need for a tall derrick.

During drilling a special mud is circulated. Fresh mud goes down through the drill tube to the bottom where it lubricates the bit and picks up cuttings. This material is pumped to the surface, the mud acting as a lubricant between drill pipe and hole. Cuttings are separated in shaking tables, and the mud is conditioned for reuse. This mud is a clay-bearing fluid weighing about 75 lb per cu ft. It usually contains a gel and other ingredients as required to control its viscosity and to seal and strengthen the wall of the well.

A great deal of heavy and expensive equipment is needed for these operations. The drawworks is a large machine of 20 tons or so, which stands just off the main drilling area. It is essentially the hoist mechanism but it also drives the rotary table. In train with the drawworks are one or more main engines with controls for supplying as much or as little power as is needed. Besides these basic components there are all sorts of pumps and generators; storage tanks for mud, cement, fuel, and water; a great deal of ordinary stuff—spare parts, tools, wire rope, welding machines, air compressors; and, of course, a lot of piping and wiring.

Among the special items is the "blow-out preventer," an assembly of devices mounted at the head of the hole below the rotary table. Its main function is to close off the hole automatically in an emergency, if a sudden dangerous pressure develops in it. The BOP unit may stand 6 ft high or more and weigh 8 tons.

Many items to store

Another special item is the drilling log. It consists of a winch which lowers an electrical probe, and a cab full of apparatus for recording data detected by the probe, data such as borehole and formation characteristics. Other devices can be attached to the cable and controlled from the cab for all sorts of operations such as measuring temperature, taking cores from the side of the hole, measuring the inclination of the hole, and so on. This equipment weighs another 10 or 12 tons and requires space.

In a medium sized rig, the derrick, machinery, equipment, and supplies may weigh 800 tons and cost three-quarters of a million dollars.

In an offshore operation, stability is the most obvious difficulty. The water may be 100 ft deep, the platform may be 40 or 50 ft above the water, and the derrick may extend 100 to 150 ft above the platform. Rigs of this sort need large legs well fixed at the bottom, secured to a rigid deck structure at the top, and braced at intermediate levels.

Wave forces may govern the design. "Wave" includes the drag of water moving past the legs, the bracing, and each well's conductor pipe; the force of currents and waves surging against the structure; and the impact of breaking storm waves. While stability calls for large legs and a lot of bracing, wave considerations call for streamlining and a minimum of exposed area. When H- or I-sections would be otherwise adequate, they might have to be jacketed with tubes to reduce drag. Another complication is the accumulation of marine growths, which significantly increase the area of underwater members. In shallow water scouring may be a problem.

If wind and wave forces are not severe, earthquake forces may be the controlling factor and require a careful dynamic analysis. The impact of barges and ships must be considered. Much of the weight involved in a drilling rig is not just standing there. The operating loads are enormous and they vary. A string of casing may weigh 150 tons and it hangs alternately on the deck and on the derrick; when tools are changed during drilling, 80 tons of drill pipe may be set aside on a small area of the deck. Occasionally the blow-out preventer has to be uncoupled from the well head, pulled up through a tight space, and its eight tons set down on the main deck in a flange diameter of something like 2 ft. When rotary table, drawworks, engines, and slush pumps are all operating simultaneously, there is a great deal of just plain vibration.

A major problem is corrosion. The air may be moist and salty; dust-laden wind may be abrasive; the water may be warm and of such a chemical composition that it reacts chemically and electrolytically with the substructure; there may even be organisms which do not exactly eat metal but continually scratch the surface, maintaining a polish that invites attack.

The alternately wet and dry "splash zone" above the water line is particularly vulnerable. Special coatings or metal jackets may be needed here. Sometimes the environment is such that the entire substructure must have cathodic protection. Success of the whole project may depend on solving the corrosion problem alone.

The size of the platform and the layout of equipment involve another set of problems. In some cases size can be determined easily—the width of the deck is simply the width of the derrick while the length is this dimension plus additional length for drawworks and engines. Usually however, it is not so simple because a number of factors must be balanced.

The layout of machinery must of course provide a good arrangement for drilling. It must include space for the crew to move around to do their jobs, and there must be a place for them to go if they have to get away quickly from the well head in an emergency. At the same time it is desirable to achieve an optimum distribution of weight on the substructure. Fortunately the functional layout is flexible and allows quite a bit of juggling, but then the structural framing tends to interfere with the nicest plans.

Deck framing is heavy, especially in rigs designed to drill an array of half a dozen or more holes. If there is no way of providing interior supports, spans are long and the upper deck becomes a network of heavy trusses that take space from the lower deck, space needed for machinery and equipment.

Another layout problem is the pipe rack. Drill pipe and casing can be picked up by the derrick from barges alongside, but in self-contained rigs a large space is set aside for pipe storage. It is a question of cost whether this is a separate, lighter structure alongside the main platform or a part of one larger platform.

Making a compact and efficient package of the drilling gear gets to be like packing a trunkful of belongings into a suitcase, a suitcase with a lot of inconvenient partitions. And offshore structures tend to become more elaborate than the preliminary scheme proposed.

Construction

Construction may present more difficulties than all the other aspects together. For an offshore platform, design is bound up with erection considerations to a greater extent than with most engineering projects. While it may be fairly easy for an engineer, once he knows all the requirements, to postulate a satisfactory structure, it may be very hard to build it. For success the engineer needs experience in heavy construction as well as in marine work.

A simple situation from the construction standpoint is shallow water and a lot of small piles in a good bottom. Another simple type is the tower substructure designed to support primarily one derrick, most other operations being handled from barges. On Lake Maracaibo there are structures such as this made of aluminum and produced in quantity. The complete substructure tower is placed in the water and anchored with steel piles driven through hollow legs.

The famous California rig, Summerland No. 1, built for Standard and Humble, was simple in concept but tricky to erect. The substructure was built in a shipyard in San Diego and floated in an upright position, using the buoyancy of the belled legs, some 200 miles to the site. There it was allowed to sink to the bottom, where it dug itself in. It was then leveled and anchored by mass concrete pumped into the bells. A huge crane lifted the superstructure and equipment into place.

An illustration of the uniqueness of most offshore rigs is the second tower built recently for the same company near the first. The substructure for this one was floated in on its side, and at the site tilted upright and sunk. It was anchored by a number of piles, which were driven through the large hollow legs into the bottom and the whole grouted together.

More elaborate schemes are needed when the site is far away and conditions do not permit the use of large equipment. Since long sea voyages involve greater insurance risks, the structure and equipment may have to be transported in pieces by barge or ship. The type of rig selected depends on the methods chosen for transportation and assembly. Deck framing and bracing schemes, for example, depend on how many legs there are. This in turn depends on the capacity of the pile driver or on whether large legs can be set without driving, as by some jetting procedure.

If these considerations call for a greater number of smaller piles than might otherwise be chosen, the bracing system becomes complicated, and for a minimum of underwater work a separate bracing structure may be required. Then the question is, is it possible to transport a bracing frame large enough to do any good? And how is it to be delivered to the bottom? How secured to the piles?

The deck structure may be too large to be transported in one piece and may have to be assembled on shore. But how is it to be moved out to the site? Transfer to special construction barges is a possibility but how is the transfer to be accomplished? Some floating scheme might work if there is a suitable harbor near enough, with enough space and a convenient depth of water, but does the budget allow a special set of construction barges in the first place? If so, will the barges be available at the time they are needed?

Without a big crane, how is the deck to be placed on the legs? Can it be jacked or raised with some sort of lift-slab device or special jacks, or can the rise of the tide be utilized? Can all the drilling machinery go up with the deck? If not, how is the machinery to be placed inside the deck later? There might have to be temporary gaps in the structure but then all the preceding phases of erection may demand perfect rigidity and tightness.

A design situation such as this is unusual, yet design procedure with almost any offshore structure is uncommonly difficult. For an ordinary building the designer may be able to work out the details starting at the roof, knowing that he can proceed step by step to the ground. For an offshore structure, the designer can't even arrange the floor plan, so to speak, until he has figured out exactly how to construct the foundations.

Unprecedented and exciting

Planning an offshore structure that can be built economically and will operate satisfactorily requires a fresh approach—even when the various conditions of site, fabrication and erection are familiar and relatively easy. As the quest for oil goes out into deeper water, engineers will have to find new solutions. They will have to forget about legs in compression and come up with something new, using buoyancy, for example, in a scheme where the drilling rig is underwater and has to be tied down by cables. Drilling technology is evolving, in fact is more advanced than is generally realized because of business secrecy. Atomic power is being developed. New processes such as drilling by sound waves may be applied. The platform idea may be abandoned entirely if drilling can be done somehow right on the bottom.

Structural engineers will be challenged in the future by problems other than the continuing removal of offshore oil. Plans are afoot now to drill through the crust of the earth and take samples of the mantle. In its reports on the work of the International Geophysical Year, *Life* (Nov. 7, 1960) published illustrations of the undersea terrain which graphically indicate the magnitude and complexity of this little-known region. As its potentialities are exploited, engineers will be faced with unprecedented and exciting marine projects.

(This article was originally presented by Mr. Willsea as a paper at the ASCE Phoenix Convention, before a session of the Structural Division.)

Compacted earth fill for a power-plant foundation

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A compacted fill supports the South Bay Power Plant of the San Diego Gas & Electric Company at Chula Vista, Calif., illustrating a new and expanding use of soil compaction techniques for heavy structures. The site is a low, flat, marshy area on San Diego Bay, once occupied by salt-water evaporation ponds. Unit 1, with a capacity of 142,000 kw, was completed in July 1960, at a total cost, for site and plant, of $23 million. Unit 2 is under construction. The site is laid out to accommodate a number of additional units, to be added as needed.

Steam power plants, by their nature, create a severe problem of foundation support. Twenty years ago, it is doubtful whether any engineer would have considered founding a major steam power-plant on an earth fill. Generally they are founded on rock or driven piles. Recently, several power plants have been founded on compacted earth fill, and are performing very well. These structures are extremely heavy, yet settlement of the completed building must be very small. Usually power plants are located near the edge of a body of water in an area that is likely to be underlain by soft soils. In many such areas, firm soil or bedrock is more than 100 ft below the ground level.

Piles, caissons, or other expensive foundations generally are used in order to reach the firm material. Although piles or caissons provide good support for power plants, they are expensive, require a long period of time to install, and sometimes cause conflicts when the time comes to add a unit. Therefore alternative methods deserve careful consideration.

The plant site at Chula Vista was underlain by 10 to 20 ft of soft soil followed by older and firmer soils. Water is at El. +2, and final grade for the plant at El. +12. One boring was put down to 210 ft in an attempt to reach bedrock, without success.

A rotary-drill rig took soil samples for laboratory tests. Electric logs were run on several borings to pick up more clearly the changes in stratification.

Other foundations considered

Several methods of foundation support were considered and evaluated. Early in the investigation, calculations indicated that a mat foundation supported on the natural soils would undergo settlements of 3 to 4 in., more than can be tolerated. Consideration was given to the use of driven-pile foundations, to steel H-piles, pipe piles, and cast-in-place concrete piles about 65 ft long to act as friction piles. The more than 210-ft depth to bedrock made end-bearing piles uneconomical. Consideration also was given to the use of surcharge fills.

Another method considered was to excavate and remove the soft soil to 10 ft below mean sea level (MSL) then replace it with fill compacted under careful supervision. This compacted fill would bear on the firm natural soils at a depth of approximately 20 ft below original grade.

Cost and convenience were two of the prime factors in the final selection of foundation type. For each unit the estimated cost of the pile foundation was $350,000, that of the compacted fill, $100,000. The surcharge method was ruled out because of inconvenience and delay. The compacted-fill method was selected, and the foundation subgrade for the first two units was placed at the same time. The actual construction cost for the completed subgrade was $94,000 per unit or $3.25 per cu yd for excavation, dewatering, hauling, and compaction of backfill. This included some higher priced gravel and other materials required for special purposes. The fill for Units 3 and 4 was placed recently at a somewhat lower cost per cubic yard.

Before the second unit was started, the compacted fill was placed for Units 3 and 4. This sequence of operations, shown in Fig. 1, eliminates excavation and compaction of fill adjacent to an existing unit. Also it provides a buffer so that while the new excavation is being dewatered, ground water under the operating unit is lowered only a small amount.

The soil selected for the major backfill was a beach-deposited, wind-blown dune sand obtained from the Coronado side of San Diego Harbor. This was not a select fill material.

A select fine to coarse sand material had been investigated from a source in the Tia Juana River Valley approximately seven miles from the site. Its anticipated delivery cost was $1.00 per cu yd while the dune sand cost a total of 70 cents per cu yd delivered to the site. The dune sand was found to be adequate provided it could be properly compacted. It required very careful handling and compaction.

For one unit the mat foundation is about 100 by 240 ft in plan dimensions. The design unit bearing pressure at the base of the foundation slab is approximately 3.7 kips per sq ft for

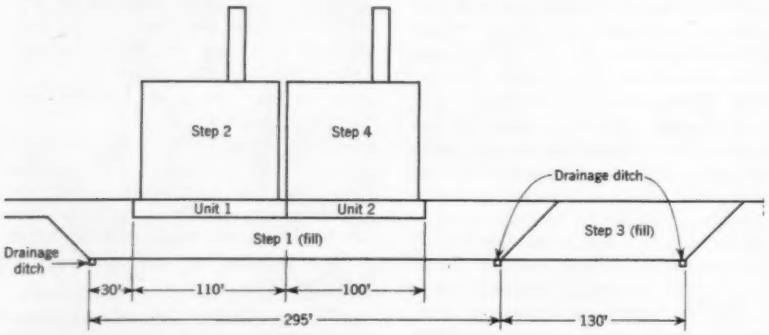

FIG. 1. Compacted fills and plant units were constructed in the order shown. Units 3 and 4 are to be built on fill at right.

the boiler half and 2.8 kips per sq ft for the turbine half of the foundation.

It was calculated that the average settlement of the mat foundation would be about 1½ in., and that settlement would be completed in about two years. The differential settlement, or tilt, was estimated to be about ¾ in. across the foundation for the turbine, which is the most critical piece of equipment. The construction schedule was such that the compacted fill would be in place 20 months before the turbine was shimmed up to its final position, so that some of this settlement would occur before settlement became critical. Also, the turbine support length is less than the foundation width. Therefore, the estimated differential settlement of the turbine supports was ¼ in., an amount which the turbine manufacturer stated the machine could take without harm.

The additional settlement of the edge of the mat foundation due to addition of a second unit was estimated to be about 0.2 to 0.4 in. Settlements were calculated as compression of the soil below the compacted fill. Anticipated compression of the fill was considered small enough to be neglected.

During and after construction, settlement records have been maintained on several bench marks. When the the soft soil had been removed and the bottom of the excavation was in firm soil, nine settlement plates were set at the bottom of the excavation, and readings were made on pipes extending up from the plates. Settlement readings were continued during the filling operation. Following that, elevations were transferred to bench marks on the concrete mat foundation. Readings were taken for some time on both the plates and the permanent bench marks. Settlement records are still being kept on the bench marks.

The primary points are that the settlement of Unit 1 was ¾ in. up to November 1960, with differential settlements of less than ⅛ in. Since Unit 2 was added, an additional ½ in. of settlement has occurred in Unit 1. Unit 2 also has settled ½ in. to date, with very little tilting. Settlements of plates and bench marks were identical, indicating negligible compression of the compacted fill.

Fill specifications

Usually, in designing a compacted fill, laboratory tests are performed on samples of the proposed fill material compacted to different densities, say 85, 90, 95 and 100 percent of one of the commonly used compaction test procedures. The samples which then perform well in shear, consolidation, and other laboratory tests serve as the basis for picking the percentage of compaction for the fill.

In this case, using uniform fine sand as a fill material, it was decided to set a percentage of compaction representing a good "relative density." A relative density of 70 percent was selected. This criterion has been used in several cases with good results. Using the AASHO method T 180-57A for compacting samples of the dune sand, a compaction curve was obtained. Samples were then compacted by other methods to obtain a maximum density. A minimum density also was obtained. The values for dry density are:

	LB PER CU FT
Maximum density, by compaction test	102
Maximum of any test, by vibration	103
Minimum, by pouring dry	85

At 70 percent of relative density, the dry density would be 97 lb per cu ft. This corresponds to 95 percent of the value obtained from the compaction test, and this was used as the compaction criterion.

Therefore the specifications required that the "Coronado Fine Sand" be compacted to at least 95 percent of the maximum dry density.

Excavation by scraper

The initial construction work required the removal of large quantities of recent alluvial soils above the water table. This was accomplished by 20-cu yd scrapers. At the same time, drainage ditches were excavated around the perimeter of both Units 1 and 2, as shown in Fig. 2. These ditches were so located that they were well beyond a 1 on 1½ slope projected outward and downward from the outer edge of the proposed mat foundations so that the uniform compacted fill beneath the foundations would have adequate lateral confinement.

The drainage ditches were excavated approximately 3 to 4 ft in width down to El. −10 to −11 MSL and backfilled with clean, ¾-in. to 1½-in. crushed rock. Perforated concrete standpipes of 42-in. diameter were installed at the four corners of the excavation to act as sumps to collect water from the rock-backfilled ditches, which was then pumped into San Diego Bay. The gravel-size crushed rock was leveled off near El. −8 and pumping was started to lower the water table. See Photo 1.

The water table was lowered at a satisfactory rate to permit the continual removal of soil. However, it became necessary to use the lighter 5-cu yd Dumptor trucks because the alluvium and clayey soils began to "pump" under the heavier equipment

PHOTO 1. Backhoe at upper right is removing the last of the alluvial soils. A 1-ft layer of gravel (light material) has already been placed over part of the site. Note drainage standpipe in foreground. This is connected with drainage ditch filled with crushed rock, which extends around periphery of site.

as the excavation was deepened. Once the surface of the in-place soils was disturbed and loaded by heavy equipment, a structural breakdown of the soils resulted, causing movement under the tires of the equipment that might best be described as "pumping." It was found best not to travel directly on the final excavated surface with any equipment after the upper alluvium soils had been removed. Also, some of the older sandy clay loam soils were found to contain irregularly deposited and interconnecting sand seams that permitted the seepage of water under slight head into the bottom of the excavation at higher elevations than the perimeter trenches.

A backhoe with a sharp blade mounted level on its cutting edge was selected for final soil removal because this piece of equipment could scrape off the final 12 to 18 in. of soil and back away from the excavated area without putting weight on it.

As this final excavation was completed, check density tests were made in the older sandy clay loam layers being exposed by the backhoe. Generally sand displacement-type field density tests were made. However, in areas where ground-water seepage made this type of testing impossible, a soil sampler with liner rings was forced into the soil, then extracted with the soil still confined within the brass rings. The rings were then trimmed, weighed and dried out at 105 deg C to determine the moisture content and dry density. The geologically older sandy clay loam was determined to be suita-

PHOTO 2. Type B vibrator is compacting saturated sand as it is towed by a small bulldozer (at left).

PHOTO 3. Elevator pit is seen after final compaction, dewatering and trimming of Decomposed Granite.

ble for the support of the compacted fill and mat foundation provided the minimum in-place dry density was 105 lb per cu ft.

Filling procedures

First a thickness of 1 ft or more of ¾-in. to 1½-in. crushed rock was placed by pushing this ahead of a small bulldozer. See Photo 1. To prevent the possible movement of the fine-sand soils into the voids in this crushed-rock base layer, a 2-in. layer of graded No. 4 to ¾-in. pea gravel was deposited, and this was covered with a 6-in. layer of the fine to coarse sand.

Coronado Fine Sand was then imported in 20-cu yd bottom dump trucks. After bottom dumping, this sand was spread in layers about a foot thick. A section showing the sloping gravel base, with various soil layers, is given in Fig. 2.

To determine what moisture content and compaction equipment would provide the most satisfactory results in achieving 95 percent of maximum dry density on the Coronado Fine Sand, test strips were prepared. Initial test results are given in Table I.

It was concluded that a minimum of three passes of the Type B vibratory compactor would produce the best results for each 1-ft layer of the Coronado Fine Sand.

Next, test strips were run using each of the two vibrators but varying the moisture content. As the moisture content increased, the degree of compaction of the sand fill also increased. It was concluded that by saturating the sand it could be compacted to the highest relative density.

The sumps and gravel underdrain served perfectly to reverse the drainage of water during excavation and were used successfully for this saturation during compaction. The best compaction resulted when the water table was maintained within three inches of the surface of the sand. Compacting the sand under saturated conditions (Photo 2) resulted in yet another problem, however, that of testing the in-place saturated sand for relative density.

Brass rings, 2.50 in. in outside diameter, machined with cutting edges, were selected for use in this testing. Each ring was 1 in. high and the cutting edge consisted of a bevel of 60 deg with the horizontal. Two non-

TABLE I. Results from initial test strips

Strip No.	Compactor* Type	Thickness of Layer, ft (loose)	No. of Passes	Average Depth of Test Below Lowest Adjacent Finished Grade in inches	Average % of Compaction
1	A	3	6	24—30	87.8
1	B	3	6	24—30	92.3
2	A	2	2	12—18	86.8
2	B	2	2	12—18	88.7
3	A	2	3	12—18	88.7
4	A	2	6	12—18	93.5
4	B	2	6	12—18	97.1
5	A	1†	3	13—18	97.6
5	B	1†	3	15—20	98.4
5	B	1†	3	6—11	96.0

* Vibratory compactor Type A was Vibro Plus and Type B was Essick.

† Tests were taken after two layers, each 1 ft thick, had been uniformly compacted by three passes of vibratory rollers.

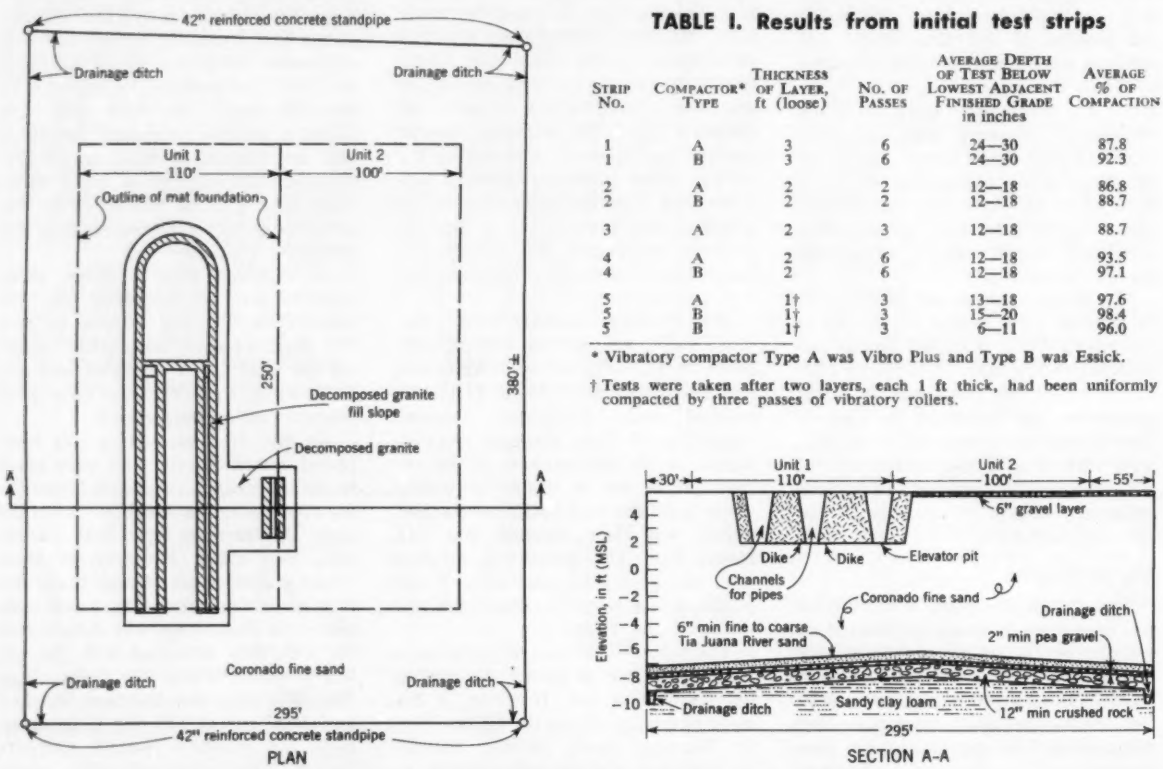

FIG. 2. Plan and cross section through foundation for Units 1 and 2.

beveled brass rings were also joined together with thin transparent tape on top of the beveled ring in order to make a sampler 3 in. high. These were next placed, with the cutting edge downward, on the excavated sand in the test pit (usually 1 ft below the adjacent grade) and forced by a flat steel-drive plate into the sand approximately 2½ in.

The upper ring was purposely left unfilled so that no pressure would be applied on the surface of the sand that might cause compaction in the test sample. These rings were then cut from the sand layer, the lower ring trimmed with a straight-edge and placed on a glass plate. The upper partially filled sample ring was trimmed off and the sand leveled in the lower two rings. An additional glass plate was then placed in contact with the sand for handling. Next the 2-in.-high ring samples were weighed on gram scales reading directly to 0.1 gram. One half of the sample was usually "quick" dried on an electric hotplate and the other half was oven dried at 105 deg C overnight to constant moisture as a final check. This technique proved very efficient.

Special fills

Dikes, 5 ft high, were constructed of Decomposed Granite especially for retaining the Coronado Fine Sand for the water intake system beneath the mat foundation. These dikes around water intake lines started at El. +0.5 ft MSL and were compacted to the base of the mat foundation at El. +5.7. See Fig. 2.

The Decomposed Granite was placed to a dozer width of approximately 12 ft to provide working width, and provisions were made to allow 2 ft of material to be trimmed back following compaction. Test strips on this material established that 95 percent of maximum dry density was best achieved by placing in 4-in. layers at optimum moisture content and giving each layer 12 passes with the type B vibratory compactor. The maximum dry density was determined to be 137.7 lb per cu ft at an optimum moisture content of 6.0 percent by the specified compaction procedures.

Obviously, it was necessary to keep the construction of the Decomposed Granite dikes approximately 1 ft above the fine sand in order to maintain only optimum moisture content in the former. The in-place density tests in the Decomposed Granite dikes were made by the sand-displacement method. The Decomposed Granite fill was being compacted at approximately 18 in. above the surrounding saturated Coronado Fine Sand fill.

After completion of compaction and dewatering, the Decomposed Granite dikes were successfully trimmed on a slope of 1 horizontal to 1 vertical to act as forms for the concrete poured around both the intake and discharge lines for the cooling water system and the elevator pits. See Photo 3.

The fill was placed and compacted between February 18 and May 6, 1958, in the rainy season. Work stopped only on days when it became too difficult for the workmen to operate the equipment.

The final average dry density of the compacted Coronado Fine Sand as determined by the density tests was 100.2 lb per cu ft; approximately 98-percent compaction. The final average dry density of the Decomposed Granite dike fill was 134.8 lb per cu ft; approximately 98-percent compaction.

Other plants on compacted fill

At least three other power plants have their foundation slabs supported on compacted earth fills. One of these, in Burbank, Calif., required excavation of approximately 20 ft of loose silty fine sand. The material excavated was recompacted back into the excavation, shrinking to 75 percent of its original volume in the process. This plant is in operation; settlement has been ¾ in. Five older units in the same facility are all supported on piles.

A second power unit supported on compacted fill is a part of the California Electric Company's plant at Daggett, Calif., due to start operation this year. The third is the Southern California Edison Company's plant at Huntington Beach, Calif. It is supported on compacted sand backfill replacing a soft soil; settlement has been about 1½ in.

Savings realized

The primary advantage of compacted earth fills, where they are applicable, is the saving realized in construction time and cost. At the South Bay Steam Plant, the saving in time was about five months for each unit.

There are two basic requirements—the fill must be compact and it must be placed on firm soil. As simple as these requirements are, a surprising number of good-quality fills are placed on compressible or unstable soils, with results that are different from those expected by the structural designer. However, this is not meant as a criticism of the many fills placed in marshland areas that provide adequate support for houses and light industrial structures.

Performance can be tailored to fit the requirements of the power plant itself. The depth of excavation, type of soil used for fill, and the density to which the fill is compacted can be varied in order to obtain any reasonable preconceived standard of performance required by the designer.

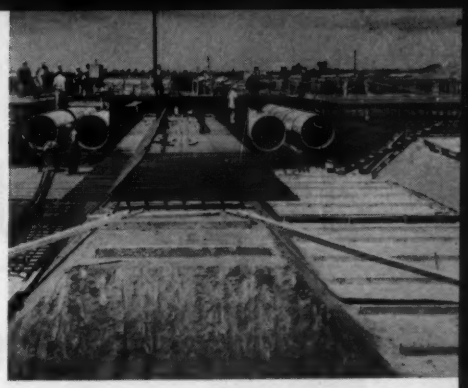

PHOTO 4. A section of reinforcing steel for the foundation mat is being placed under and around the concrete pipe intake and discharge lines. Sharp edges on the Decomposed Granite dike in foreground were trimmed with a Gradall.

When soil is used as a structural material, it deserves as careful inspection and testing as concrete, steel, or other structural materials placed above ground. If the earth fills are properly constructed, they will provide reliable support. Also, their general performance can be predicted within reasonable limits. The primary requirement for a satisfactory fill is a responsible and cooperative earthmoving contractor. Also there must be a field inspector working for the owner who observes and tests the fill, and provides unofficial advice to the contractor. This inspection must be full-time and conducted by a field engineer experienced in this kind of work.

It is desired to acknowledge the generous assistance and cooperation of the following in preparing this article, all of whom are with the San Diego Gas & Electric Company: H. A. Noble, F. ASCE, Senior Vice-President; W. A. Zitlau, Vice President, Production and Transmission; M. Hjalmarson, General Superintendent of Plant Construction; C. Hjalmarson, Superintendent of Plant Construction; J. Ellis, M. ASCE, Project Engineer.

Acknowledgement is also made of the services of the Pioneer Service & Engineering Co., for which Lee M. Davis, Vice-President, was in charge of structural design.

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Electronic distance measurement — the Geodimeter and Tellurometer

CARL C. WINIKKA, Controls Engineer, Photogrammetry and Mapping Division, Arizona Highway Department, Phoenix, Ariz.

The rather recent introduction of electronic distance measuring devices has brought important changes in surveying methods. The time required to measure a number of lines is no longer a function of their length, but rather of the number of instrument setups required and the accessibility of survey points. Projects extending for many miles can now be rapidly measured and tied to the state plane coordinate system with little difficulty. Trilateration has now become practical as another means of establishing control. (In trilateration, the position of a point is determined by measuring from or to it from two known positions. Three sides of the triangle are then used to compute the position of the unknown point.)

Two electronic distance-measuring devices have been used with success by the Arizona Highway Department —the Geodimeter and the Tellurometer.

The Geodimeter

The Geodimeter measures distance by the use of modulated polarized light, usually at night. It has been manufactured in several sizes: Model 2 for distances from 10 to 40 miles, Model 3 for 5 to 20 miles, and Model 4 for distances up to 5 miles. We selected Model 4 for surveys because of its smaller size and suitable range.

Model 4 can easily be used by a three- or four-man survey party. A 22-lb 110-v 60-cycle motor-generator or a 12-v automobile battery with an inverter can be used to supply power. When convenient the instrument can of course be plugged into a conventional 110-v supply. The Geodimeter is set on a tripod at one station and sighted on a right-angle-prism reflex unit which has been set on a tripod over the station to which the measurement is to be made. See Photos 1 and 2.

The number of reflex prisms utilized for reflector stations may be varied to a great extent. Housings are available for single prisms, three prisms or seven prisms. In addition a bracket is available which enables as many as three housings to be mounted on a single tripod. See Photo 3.

A strong narrow beam of modulated polarized light is transmitted by the Geodimeter to the reflex unit. This signal, when returned by the reflex unit, enters the receiver tube of the Geodimeter. A phase comparison between the outgoing and the incoming signal measures the delay time of the incoming signal. Readings are taken and used to compute the distance between the two instruments.

Readings usually can be taken in 15 to 30 minutes. The computation of the slope distance in feet usually requires about 15 minutes. We have found that the Geodimeter will routinely measure a distance of from one to two miles within 0.03 ft.

Although the Geodimeter requires good line-of-sight conditions it has the advantage of a light, relatively simple, reflex system. Transportation can be made somewhat easier if the reflex unit rather than the Geodimeter is used on the more difficult pack stations. The reflex unit need be pointed only approximately in the direction of the Geodimeter since its right-angle prisms will return a usable signal when the incoming beam has an angle of incidence with the prism face of up to 20 deg.

Several of the disadvantages of the Geodimeter are its inability to measure through dust, fog or smog; the requirement that it be exactly sighted on the reflex unit; and the need for separate communications. Night work may also be a disadvantage since special care must be taken to mark roads, trails, and survey points, usually with a reflective paint, so that they can be found in the dark.

Daylight Geodimeter measurements

In addition to Model 4 we now have a new Model 4B, a considerable improvement in that it can more easily be used for daylight measurements. The ability to make daylight measurements with the Geodimeter has removed what some persons consider a disadvantage; however, during the warm Arizona summers, night work has been found rather desirable.

In making any Geodimeter measurement, at least 50 percent of the light entering the receiving tube must consist of modulated polarized light returned by the reflex unit. This of course limits daylight work to relatively short distances and requires some small items of additional equipment.

The beam from the transmitting tube is so precisely returned by the reflex unit that for the short daylight measurements it has to be spread to cause a more intense signal to enter the receiving tube, located within inches of the transmitting tube. This was accomplished by the Geodimeter manufacturer through the use of wedges, that is, flat semicircular pieces of optical glass ground so that they direct the light returning to the Geodimeter by 50 sec, in a horizontal

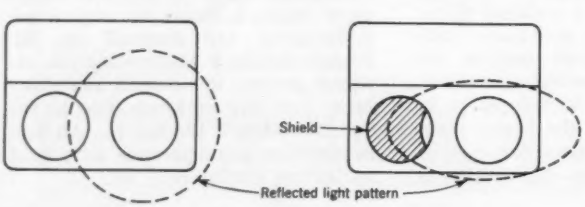


FIG. 1. Front view of the Geodimeter shows, at left, the area normally covered by light reflected by the reflex unit. At right, this area has been spread horizontally through the use of wedges, and a shield is used to reduce the percentage of extraneous light entering the receiver tube.

PHOTO 1. Closeup of the Model 4B Geodimeter shows the instrument panel.

plane. They are mounted in retaining rings that can be inserted over the front of the right-angle prisms of the reflex unit.

The other item that had to be considered was the amount of extraneous light entering the receiving tube of the Geodimeter. Since that part of the receiving tube nearest the transmitting tube receives the most intense reflected signal, a large percentage of the remaining area of the receiving tube can be covered by an opaque shield. (See Fig. 1.) This reduces the extraneous light to the point where the reflected signal makes up over 50 percent of the light entering the receiving tube. Using a seven-prism reflex unit, we have obtained very satisfactory results with the above equipment and have prepared the accompanying Table I for use as a guide in making daylight measurements.

In making daylight measurements we have obtained the best results by placing the Geodimeter where it more nearly faces the sun, that is, if an east-west line is to be measured in the morning, the Geodimeter is placed at the west end of the line. On bright sunny days our longest measurement to date has been 4,000 ft; however, measurements up to 8,000 ft have been made late in the day or on overcast days. See Photo 4. At night we have measured lines over 7 miles long.

TABLE I. Data on wedges and shields for daylight Geodimeter measurements

Distance to be Measured, Ft	No. of Wedges	% of Receiving Tube Shielded
0-1,000	5 to 7	90
1,000-2,000	5	90
2,000-4,000	3 to 5	80
4,000 up	3	70

Mean accuracies to be expected in daylight and at night

At Night		In Daylight	
Distance, ft	Mean Approx. Error	Distance, ft	Mean Approx. Error
500- 5,000	±0.02	500-1,500	±0.03
5,000-15,000	±0.03	1,500-2,500	±0.04
15,000-40,000	±0.04	2,500-3,500	±0.05
		3,500-4,500	±0.06

The Tellurometer

The Tellurometer, which measures distances by means of modulated micro-waves, can easily be used by a three- or four-man party. The master unit, powered by a 6-v wet-cell automobile battery, is set on a tripod over one point and pointed within 5 deg of the remote unit, which is similar in appearance and also battery powered. The microwave signal sent by the master unit is received by the remote unit and instantaneously returned. See Photo 5. The incoming signal is compared electronically with the outgoing signal and the results read on a cathode-ray tube in the master unit.

Several sets of readings are used to compute the distance between units. Readings can be taken in less than 15 min and the slope distance computed in less than 10 min. The Tellurometer has the advantage of being able to measure through dust, fog or smog. Its measuring signal is also used for communication between the units by means of a telephone built into each.

Over the past 2½ years we have used the Tellurometer on numerous survey projects throughout Arizona with very satisfactory results. While it can measure distances as short as 400 or 500 ft, we do not use the Tellurometer for distances shorter than a half mile because of our need to more accurately measure lines of this length. In normal operations we have measured distances to an accuracy of from 0 to 0.4 ft. The maximum single distance measured was over 139 miles, with a possible error of 10 ft.

Several disadvantages of the Tellurometer are its lack of sufficient accuracy for distances as short as a half mile; the possible adverse effect of a measuring signal reflected from flat ground or water; and the weight of

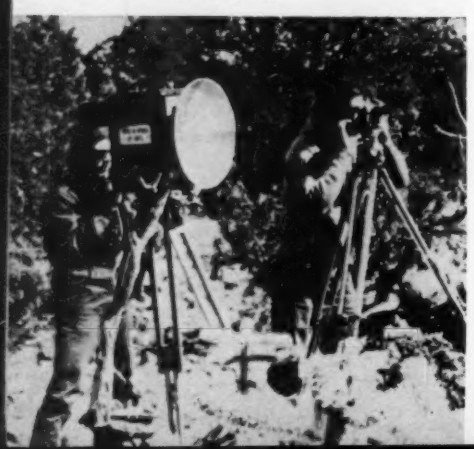
PHOTO 2. The Geodimeter employs a modulated light beam directed from one survey station to a reflector set up at a second station. In this photo a 22-lb motor generator supplies the 110-v 60-cycle power required.

PHOTO 3. Right-angle prisms in the reflex unit insure a usable signal when the incoming beam has an angle of incidence with the prism face of up to 20 deg. Shown are three 7-prism housings mounted on a single tripod.

PHOTO 4. Daylight measurements with the Geodimeter are possible for short distances (less than 8,000 ft). This feature is extremely helpful when surveys are made in difficult terrain.

PHOTO 5. Using micro-wave signals that are sent from a master unit to a remote unit and returned to the master unit, a Tellurometer can measure long distances. In this instance, a line over 30 miles in length was easily measured.

PHOTO 6. Rough levels have been carried for several miles at a time by reciprocal vertical angles and Tellurometer distances. By means of a telephone built into each unit, the measuring signal is used for communication between survey points.



the remote unit, including its power supply, in rough terrain where packing is necessary.

Electrotape

In addition to the Geodimeter and Tellurometer, a third system of electronic distance measurement known as the Electrotape has been developed and manufactured in this country. The equipment, which is mounted on standard tripods, uses micro-wave signals and a null meter readout system to determine distances. While we have had no experience with this equipment, it probably could be used in a manner similar to that of the Geodimeter or Tellurometer.

General disadvantages

Several factors inherent in distance measurement by electronic means are definite disadvantages. Distances are not measured directly in feet; the signal transit time must be converted to feet. A predetermined distance cannot be measured directly since the measured distances are the slope distances, and vertical angles or differences in elevation are needed to reduce them to the horizontal. To measure a predetermined distance it is necessary to set an approximate point, measure the distance to that approximate point, compute this distance, reduce it to horizontal, and then chain from this now known point to the required point.

Several projects on which the Tellurometer or Geodimeter have been used will serve to illustrate techniques that have been successfully used in Arizona.

Straight-line control

For photogrammetric mapping, the method of placing horizontal control points along a straight line and measuring the distances along the line with the Tellurometer has worked very well on a number of projects. On several of these projects high points were selected as primary points and intermediate points were set on line and measured by a field man who moved from point to point with a remote unit. Distances between intermediate points were computed by subtraction, and wherever a check on the position was required, a measurement was made to another of the primary points. Whenever possible, all points used for horizontal control were premarked with a white material, usually in the form of a cross, which was visible on the aerial photographs.

The straight-line method not only reduced field time but simplified computations. Base sheet layout was faster and azimuth control was easily maintained in the stereoscopic plotting instruments during routine plotting as well as during stereotriangulation.

After our maps have been completed, a study is made to select the most feasible alignment, which must then be located on the ground. On projects mapped at scales smaller than 1:1,200, the tentative line has been located on the ground by certain physical control points. For example, it may be required that the line miss a high transmission tower by 200 ft or cross a stream at a certain point. In areas where no such specific points are indicated, the tentative line, on maps of this scale, can be located on the ground with sufficient accuracy by resetting the map in the stereoscopic plotter and photoidentifying the alignment points needed to control the line on the ground.

It should be pointed out that in locating a tangent only two points so selected and established in the field can be used to represent the tangent. Other points thus identified on the same tangent serve only as a general guide in the field.

General alignment survey

Once points were set in the ground and the centerline field checked for any possible alignment changes, measurement of the line was rapidly accomplished. These center-line surveys were always closed to verify the correctness of the final computed distances. One of the important advantages in using the Geodimeter or Tellurometer on such work has been the ability to carry stationing along the line in long "steps," if necessary to the point where a design survey is needed. Later chaining to "station" the line need not be carried out with normal precision since the stationing can be adjusted at control points spaced as needed. For setting closely spaced points, 1,000 to 2,000 ft apart, we use the Geodimeter. Chaining is adjusted at each of these points.

This application of the Geodimeter to provide accurate center-line points for chaining has been used on several projects to permit much faster chaining and at the same time maintain a high order of accuracy along the centerline.

Design alignment survey

While photo-identification of survey points may be of sufficient accuracy for maps of intermediate scale, as described above, the transfer of a precomputed survey line from a design-scale map to the ground requires an accurate field survey. Since the design map has been used for earthwork and the geometry of the design centerline has been fixed, the importance of accurately surveying the centerline in

the field to make it coincidental with the alignment on the map is of the utmost importance. Any error of swing or accumulative distance will cause a lack of agreement between the centerline in the field and on the map. Many times a lack of correlation between a map and the ground has led to the erroneous inference that earthwork quantities determined photogrammetrically were inaccurate.

In establishing a precomputed line in the field, the Geodimeter and Wild T-2 theodolite with associated equipment have been shown to yield excellent results. Since no two projects are alike, the application of these instruments can vary widely. To establish the centerline in the field we have intersected required points directly from map control points, measured the centerline itself, measured a Geodimeter control line from which the required points could be intersected or measured, or we have used various combinations of the above.

In rugged country the intersection from known more accessible points permits the line to be established on the ground in less time with a minimum of packing. Most of our surveys establishing new centerlines with the Geodimeter have been closed to an accuracy of better than 1 in 100,000.

Vertical control

Rough levels have been carried by the use of reciprocal vertical angles and Tellurometer distances. On a recent project which involved distances up to 7 miles, trigonometric leveling was used to carry elevations for 67 miles. The final elevation checked a known elevation by less than 7 ft. This method of carrying elevations has also been used for wing points by setting the master instrument on a high point of known elevation and measuring distances and vertical angles radially to the wing points photoidentified by the person using the remote unit. Whether or not reciprocal angles are needed is governed by the accuracy required for the wing-point elevations. For 10-ft contours on a map to a scale of 1:4,800, wing points need be only within 2 to 3 ft of the true elevation. A single Tellurometer measurement several miles in length, with reciprocal angles, will yield an elevation well within one foot of the true elevation. See Photo 6. The effect of reciprocal angles can easily be computed and a decision made as to when a single adjusted vertical angle will suffice.

Property ties

Ties to cadastral survey marks or other property monuments can be easily accomplished using electronic distance measuring devices; however, the intervisibility requirement can often cause much difficulty. See Photo 7. In rough terrain it has been found by experience that the point requiring a tie always falls just out of sight over a hill or down in a canyon. Add cactus and a scattering of rattlesnakes and you have a survey problem that is difficult at best. A subtense bar can be used to great advantage in such terrain by measuring short distances as the line is being "hubbed" out. In most cases it has been advantageous to have the line ready before moving in with the Geodimeter or Tellurometer. It is then known just where distance measurements are needed.

Small projects

When a relatively small area is to be mapped photogrammetrically it is often feasible to accomplish all the field work on one trip. Design maps of bridge or interchange sites fall into this category and have been mapped successfully in very short periods of time. The economic advantage of one trip to the site has been combined with the advantage of premarked control and electronic distance measurements. In this way it is possible to provide, in a minimum of time, adequate control that can be positively identified.

Recently a canyon bridge site map was completed in less than 8 working days after beginning field work through the use of pre-marking, coordinated flying, trigonometric leveling and electronic distance measurements. The steep-walled canyon at this site was approximately 400 ft deep and 1,000 ft across.

On this project it was felt that distance measurement by Tellurometer provided sufficient accuracy for map-scale control. Control for the bridge structure is a different matter and it is planned to use Geodimeter trilateration and triangulation to provide a check of the Geodimeter base measurement across the canyon.

Centerline check measurements

A project illustrating the use of the Tellurometer to aid in centerline chaining was undertaken on the Navajo Indian Reservation in northern Arizona. A new third-order centerline survey 55 miles long was in progress, the distances being measured by chaining. The line had been established on the ground and chaining had progressed along a part of the 55-mile project when we were asked to make Tellurometer measurements of the line. We were to provide distances between selected points to avoid the need for double chaining. In three days Tellurometer measurements were made over 44 distances covering the 55-mile line. The computations were all checked and in a few days a complete tabulation of slope distances was furnished.

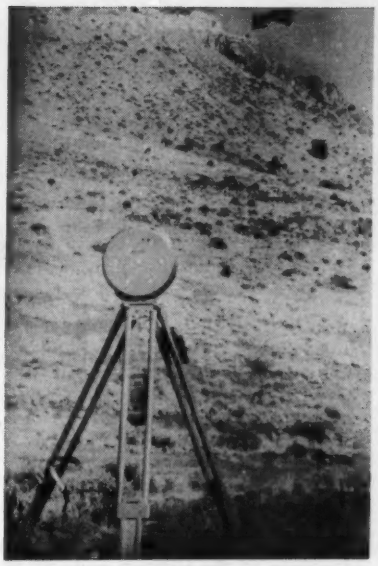


PHOTO 7. In steep terrain accurate positions can be established with little difficulty. In this view from behind the tripod and reflex unit in the foreground, the Geodimeter can be seen as a dot (at arrow) on the skyline near the highway cut. Photo 4 is a closeup of the Geodimeter at this station.

With these data, chaining and stakeout were accomplished without the need for double chaining. No adjustments to the Tellurometer distances were made since these measurements served only as checks.

Our work with the Tellurometer and Geodimeter have shown these two instruments to be equally good in performing work within their capabilities. The Tellurometer is designed to measure distances from a few miles up to 50 miles, but it can be used with some sacrifice in accuracy to measure lines down to several hundred feet in length. The Geodimeter bridges the gap, so to speak, by providing accurate distances in the range between short chaining work and Tellurometer control surveys.

It is believed that the new measuring equipment will play a role of increasing importance in surveying and mapping by making possible the rapid preparation of more accurate maps and surveys.

(This article is based on the paper presented by Mr. Winikka at the ASCE Phoenix Convention, before a session of the Surveying and Mapping Division.)

A new shape for a storage structure

GEORGE E. WEATHERFORD, A.M. ASCE, Civil Engineer, Central Soya Company, Inc., Fort Wayne, Ind.

A structure of conical shape takes advantage of the natural angle of repose of soybeans to provide economical storage for two million bushels of this commodity at Chattanooga, Tenn. The owner is the Central Soya Co. of Fort Wayne, Ind.

The shape of the structure, that of a cone resting on a circular embankment of earth, was chosen because of ease in filling. The bean pile as it grows will assume the shape of the building. The angle of repose for soybeans lies between 24 and 27 degrees, depending on the moisture content and the amount of extraneous material present.

The building is 300 ft in diameter and has a height of 100 ft from the floor to the peak of the control house. The lower 21 ft is enclosed by a mound of earth. Above this comes the structural steel framing, which is conical in shape and covered by a roof of corrugated steel.

Material for the mound of earth that serves as the building wall came from a borrow excavation nearby. It was compacted in 6-in. layers by a 10-ton sheepsfoot roller, using a minimum of six passes of the roller per layer. On the inside the embankment slope is covered with a concrete slab, and on the outside with stone. Because of the slope of the embankment, a sprayed-on concrete was employed rather than conventionally placed concrete. A 28-day strength of 3,000 psi was specified for the concrete, which had almost a zero slump at the time of placement.

Pile-supported footings

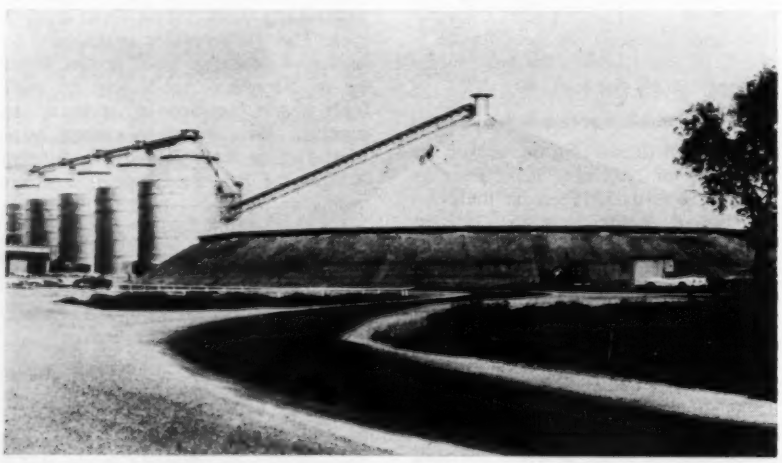
The sloping roof, framed from simple rolled sections, is supported on 16 interior footings and 32 exterior footings around the periphery. Each of the interior footings is supported by four straight piles. Of the 32 exterior footings, 16 are supported on three piles each, two of which are on a batter. Alternate exterior footings are supported on two piles each, one of which is on a batter.

An auger drill of 20-in. diameter was used to cut through the embankment before the piles for the exterior footings were driven. This was done to eliminate the load from the earth, which might be added to that on the piles when and if the embankment begins to settle.

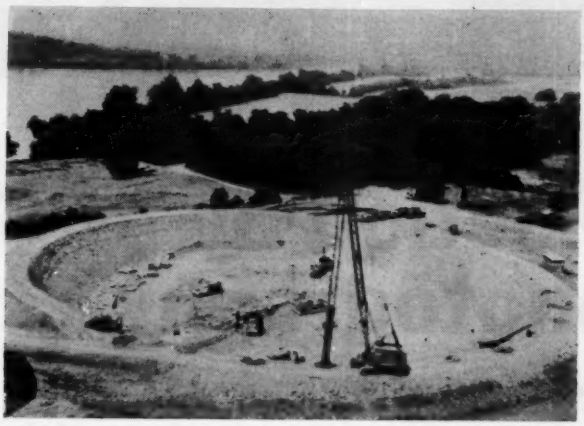
The floor of the building has an asphaltic concrete surface underlain by crushed stone. Below this is a grid system of drain tile, which empties into a ditch leading to a nearby river. This tile is expected to eliminate any possibility that ground water will get to the stored beans.

The roof framing consists of 32 sloping 27 WF rafters on the outer section, 16 of them terminating at 18 WF beams framed between the interior columns. See Fig. 1. The other 16 rafters are cantilevered a distance of 60 ft horizontally beyond the columns to the peak of the building, where they are connected into a ring formed by an 18-in. channel. The outer ends of the rafters are supported directly on the exterior footings. Thrust is resisted by the batter piles. Much of the vertical load is carried by the interior columns because of the cantilevering. The rafters support open-web steel joists spaced 4 ft 6 in. on centers. All major connections in the building are welded with the exception of the rafter and column connections to the footings.

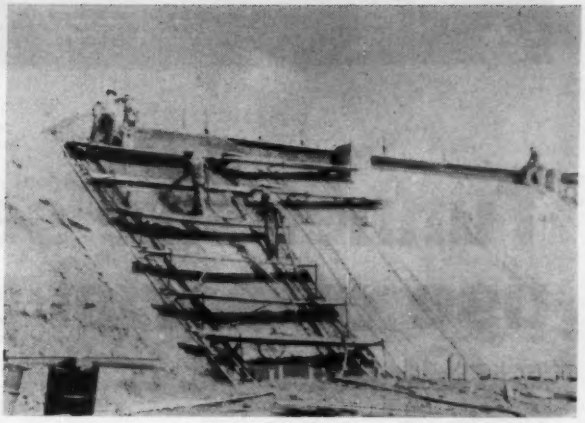
The roof sheeting is 22-gage galvanized metal connected to the joists by studs. These studs are positioned with the aid of a template, then welded to the joists. Sheets are laid over the studs; an aluminum burr, together with a neoprene washer, is applied to the shank of each stud. The shank is then



Structure 300 ft in diameter consists of an earth embankment 20 ft high topped by a conical roof to provide storage for 2,000,000 bushels of soybeans at a cost of less than 20 cents a bushel.



Holes were augered through 20 ft of embankment before the piles were driven for roof support.



Concrete for slope paving on interior wall was sprayed on, utilizing wire-mesh reinforcement.

flattened, drawing the sheet tight. Studs are installed through the high corrugations only.

Handling equipment

Fresh beans—brought to the building from barges, freight cars, or trucks—are first screened to remove all dirt, weed seeds, and other extraneous material. From the screen they go on a 222-ft conveyor belt for movement to the top of the storage building, where they are discharged through the center ring. As the pile is built up in this way, it conforms to the shape of the building.

The conveyor is supported on top of a three-span bridge (70 ft, 90 ft, 62 ft), which is 4 ft deep and about 4 ft wide. It carries the 30-in. conveyor belt on top and a catwalk 2 ft wide at one side.

Temperature detection system

In order that the condition of the beans may be known at all times, there is a temperature detection system in the storage structure. Detection is accomplished by electrical devices, which are hung by cables from the ceiling of the building so that they will be positioned throughout the pile. This thermocouple system transmits electrical impulses created by temperature conditions. Whatever the disturbing condition may be—insects, moisture pockets, dirt and chaff, or molds that affect the relative temperature—an impulse is created, detected, and carried to the temperature indicator panel, located at the top of the building.

Stored material is reclaimed by a belt conveyor located under the floor in a reinforced concrete tunnel 209 ft long. Beans are removed through hoppers set in the floor. The procedure is to start at the center of the building and work toward the entrance at the outside wall. Since this process does not remove all the beans, a front-loading vehicle is brought in on a ramp to push the remaining material into the hoppers.

The cost of the building—including the structural steel bridge, the reinforced concrete tunnel and all machinery, as well as the relocation of a road and parking lot—amounted to less than 20 cents per bushel.

Architects and engineers for the project were W. A. Darling & Associates of Fort Wayne, Ind., in cooperation with the engineering department of the Central Soya Co. The latter is under the direction of J. F. Azbell, engineering manager for the company. The field engineer in charge of the project for Central Soya was Herman Von Gunten. The general contractor was the Stein Construction Company of Chattanooga, Tenn. Structural steel was fabricated by the Mississippi Valley Structural Steel Company at its Chattanooga plant.

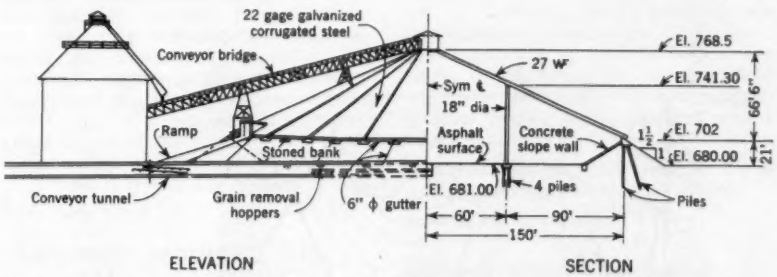
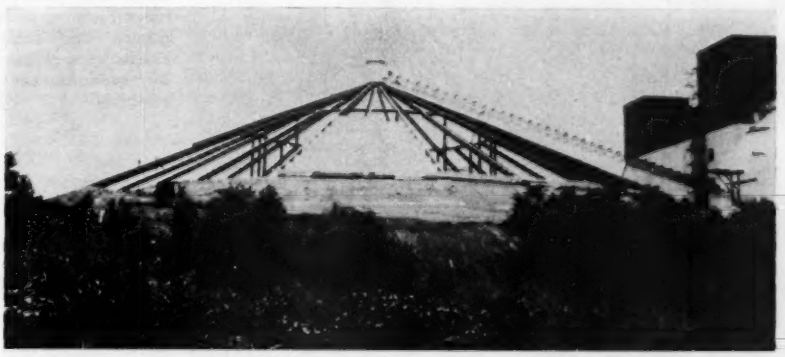


FIG. 1. Roof is cantilevered on a slope approximating that of a soybean pile to provide economical storage for this product for Central Soya Co., Inc., in Chattanooga, Tenn.



Roof framing for this unusual soybean storage structure is seen under construction.

Tunnel-site selection by use of aerial photography

THOMAS W. MITCHAM, Department of Geology, University of Arizona, Tucson

Geologic evaluation of tunnel sites was a minor but a critical part of an Interstate Highway location study recently conducted for the Colorado Department of Highways. The area studied, about 100 miles long and 50 miles wide, lies across the Rocky Mountains west of Denver, between Dotsero and Empire Junction.

From the 8 basic routes selected in the preliminary phase, two alignments were chosen for full detailed study. Geologic factors were given careful attention both in the preliminary and in the detailed studies. A number of tunnel sites, ranked from suitable to ideal, as regards topography for approaches and portal separations, were poor geologically. The geological evaluation was based primarily on mapping from aerial photographs although some field checking was done.

The use of aerial photographs in mapping tunnel-site geology marks a great advance. For example, some faults that are likely to be undetected even after detailed field study, are quickly brought into focus on aerial photographs. One tunnel site considered during the highway location study was on an alignment of NNE under Berthoud Pass (Fig. 1). Aligned drainages, heading toward the pass from each side, provide good approaches to portals and the opportunity to design a relatively short tunnel. Geologically, however, this site is very poor since the alignment would follow a major fault zone. This conflict between favorable topography and unfavorable geology was found at some of the other tunnel sites studied. The situation at Loveland Pass is almost exactly parallel.

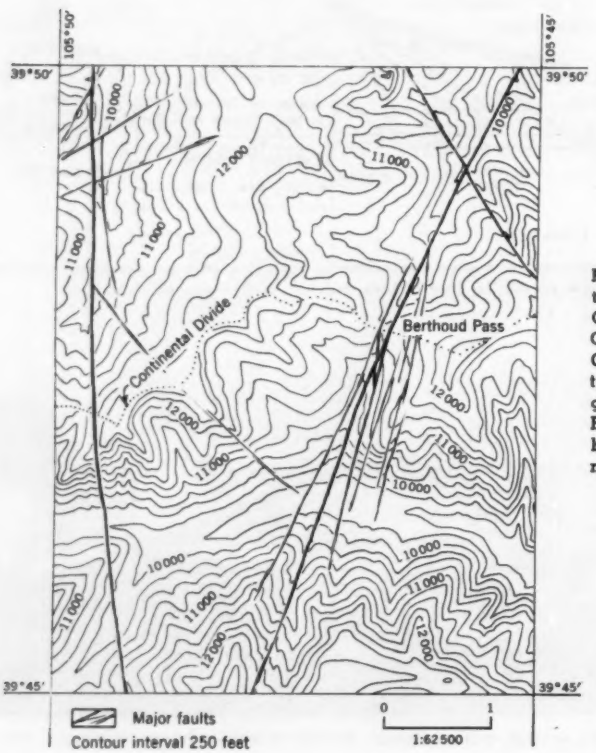


FIG. 1. In the Berthoud Pass area, in Grand and Clear Creek Counties, Colorado, bedrock types are granite, gneiss, and schist. Faults were mapped by reconnaissance methods.

In preparation for this location study, conditions in various tunnels in the Colorado Rocky Mountains were analyzed. The general conclusion drawn is that rock type is not so important a consideration as rock structures and rock alteration. Rock structures that provide planes of weakness, such as faults and other fractures, bedding, and foliation, are particularly critical.

In selecting a tunnel site, the essential geologic objective is to plan the alignment so that it is as nearly as possible at right angles to the dominant planes of weakness. If a tunnel were to be aligned so that it would follow a major fault zone, as would be the case from all indications at the Berthoud Pass site, the result would be disastrous.

The study here discussed was conducted by the E. Lionel Pavlo Engineering Co. for the Colorado Department of Highways. The writer is grateful to the company's president, Dr. E. Lionel Pavlo, for permission to publish this article.

(This article is based on the paper presented by Professor Mitchum at the ASCE Phoenix Convention, before a session of the Surveying and Mapping Division.)

THE READERS WRITE

Why introduce still another system of measurement?

TO THE EDITOR: With reference to the article in the June issue by Bernard L. Weiner, "Decimal System, Yes; Metric System, No," I feel that a move to such a system would be an improvement, but it would be only a step in the right direction. We would still have a system different from most of the world, and we would have undergone almost as much confusion and difficulty as if we had made the complete change to the metric system.

We members of ASCE should actively promote a change to the metric system at the earliest practicable time, and we should not confuse the issue by presenting still a different system for consideration.

DOYLE KENNEDY, M. ASCE
Manager, Kennedy Construction Co.
New Smyrna Beach, Fla.

A plea for quick adoption of the metric system

TO THE EDITOR: The writer is not certain whether the article, "Decimal System Yes, Metric System No," by Bernard L. Weiner in the June issue, p. 58, is intended to be taken seriously. At any rate, it should create much interest.

In the field of water supply particularly, our use of gallons, cubic feet, pounds, cfs, mgd, gpm, acre-feet and all the rest, draws an indulgent smile from the enlightened foreign friend who lives with the metric system of liters and meters. Anyone exposed to the metric system must surely be impressed by its order and simplicity.

Mr. Weiner scorns the meter as a purely arbitrary unit. This is to say that the foot, the gallon and the pound are not arbitrary? And we are now urged to have larger inches and smaller gallons?

Is it seriously suggested that we operate with these new units inside the United States, the old units in certain other areas, and the metric system in still others? And we are further to instruct the misguided 90 percent of the world's population to throw off its metric chains and embrace our new order?

From the background of recent professional experience in Latin America and the Far East, the writer can only plead for quick adoption in this country of the metric system, so that we can catch up with our developing friends!

HARRIS F. SEIDEL, M. ASCE
Director, Water and Sewage Treatment Department
City of Ames
Ames, Iowa

A foot with ten inches used in China

TO THE EDITOR: Your June number has just come and I have read with great interest the article by Bernard L. Weiner (p. 58) about a decimal system—not metric.

For 40 years as an engineer-turned-architect for the Board of Missions of the Methodist Church, I lived in China or worked among Chinese "in dispersion." The old Chinese measurements were all in feet, divided decimally. The trouble was that every trade and business had its own foot, a different length from that of every other trade.

We adopted the English foot and divided it into ten "inches." There was not the slightest confusion. Everybody learned that "Mr. Wiant's foot" was the English foot, and *of course* it had ten inches and a hundred hundredths. The builder's foot was only a quarter of an inch short of the English foot, so for dimensions less than a foot it was all right to use the Chinese rule. For long measurements American-made tapes, decimally divided, were used.

One anomaly I have never quite understood is that American engineers in the field will take all survey measurements in feet, decimally divided. Then, back in the office, they will plot to a scale of tenths and hundredths of *inches*. In China our maps were always decimally drawn with the foot as a unit: 1/200, 1/500, and for larger areas, 1/1,000 or 1/5,000.

PAUL P. WIANT, Life Member ASCE
Saint Paris, Ohio

"Corporate practice," the root of the controversy

TO THE EDITOR: Permit me to compliment Mr. Gongwer on his article in the May issue, "Corporate Practice as Defined in NCSBEE Revised Model Law"; also ASCE for its concern about this important matter. It would have been fortunate if the title of the article had not included the term "corporate practice" because that term is the root of the controversy. The term should not be permitted in a professional discussion.

A professional activity is an individual and personal activity, and cannot be exercised by an artificial corporate person. To preserve the dominance of the professional individual and his responsibility, while giving him advantages of a wage earner inherent in corporation organization, can be the only valid consideration for permitting engineers to practice within a corporate body. These are safeguards to preserve this dominance in the stands of ASCE and the Consulting Engineers Council on the problem. There are no effective safeguards in the Model Law. ASCE is to be complimented for its perserverance in trying to obtain a remedy.

BENGT F. FRIBERG, F. ASCE
Consulting Engineer
St. Louis, Mo.

Goal of fluid mechanics, to understand our environment

TO THE EDITOR: Your May issue contains an article, on p. 63, entitled "Fluid Mechanics—Its Scope and Challenge," by George Bugliarello, A.M. ASCE. The article is very stimulating and presents the study of fluid mechanics in an exciting manner.

The understanding and utilization of the environment is the goal of all scientific endeavor. Nature presents us with a set of circumstances or laws. If we are aware of the most pertinent and important ones, and understand how they influence a particular problem, we can reasonably predict what the solution to that problem will be. We do not control nature; we merely understand it.

The scope and challenge of fluid mechanics is not what the article states it to be: ". . . shaping our environment into the connective tissue of our civilization." In common with all other fields of nature study, the challenge and scope of fluid mechanics is to understand our environment so that we can learn to live with it better.

CHARLES D. D. HOWARD, A.M. ASCE
Graduate Student, Univ. of Alberta
Edmonton, Alta., Canada

Culvert design curves of limited application

TO THE EDITOR: In the article, "Culverts Designed from Curves," by Eugene S. Thomas, in the May issue, p. 70, no indication is given as to the very limited application of the method. In the first place, formulas of the Wentworth type are generally not applicable to culvert-size drainage areas, on two counts: (1) hydrology is just not that simple, and (2) the method does not take into account the hydraulics of the culvert—entrance losses, roughness, slope, length, head, etc.

The attempt to justify the Wentworth curve by application of the rational formula involves rainfall and runoff assumptions quite unwarranted even for a particular locality. Furthermore, Fig. 2, used to translate Q (as derived from the rational formula) to area of opening, does not produce the values in Fig. 1.

Fig. 2 is a solution of the Chezy formula for long pipes flowing full, with Kutter's $n = 0.015$. If it had any application in culvert practice, it would be limited to concrete pipe or other material of comparable wall smoothness. The points on Fig. 1 can be approximated by solution of the Chezy formula with $n = 0.024$, which is proper for corrugated metal, and perhaps the wrong chart was inadvertently reproduced as Fig. 2.

To illustrate how inconsistent the application of the rational formula as used in this article would be in the State of Washington a comparison was made of runoff data for all drainage areas of less than one square mile listed in the U.S.G.S. publication, "Floods in Washington, Magnitude and Frequency," an Open File report published by the Tacoma office, U.S.G.S.

It was found that flows provided for by the procedures described would be from 2.1 to 32.7 times those computed for floods of 50-year frequency, based on U.S.G.S. runoff measurements at gaging stations below each of these areas. Also, if the curve is intended for corrugated pipe, and assuming that all culverts are long, on the same grade, and have no head on the entrance or entrance losses, the method would still be wastefully conservative in pipe sizing, if used with concrete pipe, over and above the Q variation.

LELAND L. SPHAR, F. ASCE
Engr.-Manager, Concrete Products Association of Wash.

Seattle, Wash.

"Delta" girder's torsion box will take tremendous load

TO THE EDITOR: In his article on a steel delta girder (May issue, p. 50), Homer M. Hadley states that the test results on Girder 4 surprised him.

The torsion box created by the added plates is good for 1,400,000 in.-lb on each side of the applied load, while the bearing stiffeners are good for 470,000 in.-lb at each end. The true line of thrust may have passed through any point in the lower flange, creating a minimum moment in the end-bearing stiffeners of only $100{,}000 \times 7 \times 9/18 = 350{,}000$ in.-lb.

CEDRIC MARSH
General Eng. Dept.
Aluminum Co. of Canada, Ltd.

Montreal, Canada

New ideas bring profit to entire economy

TO THE EDITORS: The article, "Lower-Cost Canal Linings Through Mechanization," by Carl R. Wilder (June 1961, p. 39), is a salute to the Bureau of Reclamation and the Corps of Engineers, U. S. Army, for their wholesome and fair approach to progress through prompt acceptance of new methods and developments. This attitude of permitting freedom of development, so long as end-product quality is maintained, is most valuable in encouraging progress.

The article "Developments in Bituminous Concrete Paving," by H. A. Radzikowski (July 1961, p. 40), advocating prompt acceptance of new ideas in this field, is of considerable value as this direct word from the U. S. Bureau of Public Roads may encourage state and local governments to take action.

This is an area where more flexibility and quicker acceptance of new ideas can save considerable money for the taxpayer.

Encouragement for additional development and new items of "hardware" and materials for construction must come at least partly from profit. The developer should not be required to adjust prices to return the savings on a new idea to the owner. The incentive of profit will result in worthwhile gains to the entire economy.

R. M. GUNTERT, *President*
Guntert & Zimmerman Construction Div., Inc.

Stockton, Calif.

"Plastic" design of aluminum

TO THE EDITOR: The use of the plastic theory to design an aluminum structure is, unfortunately, unacceptable when bolted joints are used. This comment is prompted by the article, "Plastic Analysis Supplements Design of Aluminum Structure for Reactor Research," by Messrs. Wichman and Ahlers (May issue, p. 60). Even in steel frames the use of bolted joints is not compatible with the use of the plastic theory. In aluminum this applies with even greater force because of the limited elongation available at bolt holes.

The view expressed in this article that yielding in aluminum alloys is tantamount to collapse would rule out plastic design completely, but fortunately this is not true. With aluminum, as has been traditional in steel, reliance is placed on plastic behavior in many of those details where elastic analysis is difficult. In aluminum, because of the lower elastic modulus, deformations are greater than in steel, but secondary stresses due to these deformations are of the same magnitude.

For an efficiently designed structure, the lower working stress for aluminum has not usually meant more robust members. On the contrary, the need for economy has led to a spreading out of the metal to extract the greatest possible structural efficiency.

I would be interested to know whether or not this structure would have been cheaper if the designers had thrown away the handbook and designed shapes specifically for the job, getting one of the aluminum companies to extrude the sections for them. This might have saved as much as $0.30 per lb of the fabricating cost, while providing a lighter and cleaner structure.

CEDRIC MARSH
General Eng. Dept.
Aluminum Co. of Canada, Ltd.

Montreal, Canada

Authors' reply

TO THE EDITOR: Regarding Mr. Marsh's comments on our article, "Plastic Analysis Supplements Design of Aluminum Structure," in the May issue, we wish to offer the following explanations.

We believe that a bolted joint, either steel or aluminum, when designed and detailed specifically with plastic behavior in mind, can be relied on to transmit forces from one member to another for predictable plastic hinge development. Essentially, in such a design, properly tightened bolts would be used, and connecting members that would be free from local bending deformations.

Bolts in this structure are set in tight holes and are designed not to fail in shear before hinge development in columns. The 2024-T4 aluminum alloy bolts with a 40-ksi yield strength were tightened to a point where yielding was felt to be imminent (threads were lubricated). In view of the high static friction coefficient of aluminum on aluminum, we believe that the clamping force is sufficient to resist joint slippage.

A rigid-frame structure with bolted connections is even more sensitive to joint slippage when designed in accordance with the elastic method. Because the theory does not make any allowance for internal load redistribution, any slight movement in the joints would upset all the efforts put into a rigid-frame analysis, and the structure eventually would act more in keeping with the plastic concept.

As far as steel is concerned, our view on compatibility of bolted joints with plastic theory is but a restatement of the principles set forth by a group of eminent engineers in their "Commentary on Plastic Design in Steel: Connections," the paragraph entitled, "Details with Regard to Bolting" (*Journal of Eng. Mech. Div.*; ASCE Proc., vol. 86, No. EM 2, April 1960). For aluminum, we concede that the above statement is at present only an opinion which requires strengthening through more research and testing.

It is not our view that an aluminum structure will collapse immediately after the formation of plastic hinges. We wished to stress that, because of the wide difference between the plastic deformational range of steel (from 33 ksi to 60 ksi) and that of 6061-T6 aluminum (from 35 ksi to 38 ksi), another approach should be used for determining aluminum's plastic load factor. We used a rather arbitrary factor of 2.8 for aluminum (as compared with the established factor of about 1.85 for steel), but again, we hope that a more correct load factor will soon be established through research and testing.

Long-established success with cold-driven aluminum rivets, including those of structural alloy 6061-T6, bears testimony to the plastic behavior of aluminum. Any material with even a slight difference between the elastic limit and the rupture stress could be analyzed in accordance with the plastic concept, which in essence defines the mode of failure and not the behavior of a structure under service conditions.

Mr. Marsh is correct in stating that secondary stresses in aluminum structures do not change, although the deformations may be three times as large as those in corresponding steel members. In this particular case we were faced with unusual alignment problems, and a column shortening of more than a tenth of an inch was considered not allowable.

For the same reasons of alignment, lighter members were not sought. Aluminum was chosen for this structure not because of its weight but because of its nuclear properties. We did not investigate the use of specifically designed and extruded shapes, since our judgment was, and still is, that for orders of less than ten tons such a procedure could not be economical in our location.

We wish to thank Mr. Marsh for so thoroughly analyzing our article and for sending in his notes. We consider his criticisms constructive and stimulating. Such discussion is sound and necessary for the proper development of demanding but practical engineering problems.

SVEN H. WICHMAN, M. ASCE
GORDON K. AHLERS, F. ASCE
Facilities Engineers, Brookhaven National Lab.

Upton, Long Island, N. Y.

Serving the public interest—a matter of vital importance

TO THE EDITOR: With great satisfaction I have read the timely article, "The Engineer's Obligation to Disclose All the Facts," by Adolph J. Ackerman, F. ASCE, in the March 1961 issue, p. 60.

As an ordinary citizen as well as engineer I wish to express my heartiest thanks for bringing to the attention of our profession (and I hope to many in other fields) a matter of extreme importance in the development of civilization—of even more importance than the profession itself. For without a fertile political, moral, and economic climate, the profession, per se, would cease to exist, and the progress of society would come to a halt—perhaps even ebb—plunging the world into a new dark age.

I refer particularly to the current trend in this country away from the principles of individual freedom, moral responsibility, and personal independence on the basis of which we, as Americans, have been able to acquire the highest standard of living the world has ever known. In place of those bright tenets of progress, we are substituting the dogma of a debilitating collectivism which, if not stoutly resisted, will engulf all the professions, reducing their members to mere technicians and puppets of ignorant or unscrupulous politicians and bureaucrats—who are even now forming a new élite to which all the rest of us will be subservient.

The engineering profession occupies a critically important position in this situation for two reasons. First, without its supporting knowledge and skills, the bureaucracy would be helpless in many areas of prime importance to the furtherance of its aims. Second, the profession, with its very existence at stake, can easily lose by default unless it maintains an aggressively moral and ethical attitude of unswerving integrity in "serving the public interest above all others."

So far as I am aware, the current article is the first on this momentous subject. There should be many more, and the time is very late.

ALFRED OGRAM, F. ASCE

Orlando, Fla.

To find the radius of a curve

TO THE EDITOR: Mr. Kagan's article, "To Find the Radius of a Curve," in the May issue, p. 70, is in effect equivalent to the problem of finding the radius of a curve when the *difference* between its arc and its chord is given. If this difference is called the "arc excess," then it may be shown that

$$\text{Arc excess} = 0.127\ (D/10)^2 \quad . . \quad (4)$$

where D = degree of curve
r = radius = $5{,}729.578/D$ ft

Equation 4 is true to the nearest hundreth of a foot for all values of D up to 34 deg (where $r = 168.52$).

As an example, suppose the arc excess (difference in length of the given arc and chord) equals 1.0 ft. Then $1.0 = 0.127\ (D/10)^2$; $(D/10)^2 = 1/(0.127) = 7.874$; $D/10 = 2.806$; $D = 28.06$ deg, from which $r = 5{,}729.578/28.06 = 204.2$ ft.

T. F. HICKERSON, F. ASCE
Formerly Prof. of Civil Eng. Univ. of North Carolina

Chapel Hill, N. C.

★ ★ ★ ★

TO THE EDITOR: Perhaps Mr. Kagan and other readers may be interested in a different approach to the solution of his problem, "To Find the Radius of a Curve," in the Engineers' Notebook for May, p. 70.

Using Mr. Kagan's notation, the problem actually is to solve the equation,

$$\sin \frac{b}{r} = \frac{a}{r} \quad . . . . . \quad (1)$$

for the radius, r, where b/r, in radians, is Mr. Kagan's angle α.

The sin b/r may be expanded according to

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots \frac{(-1)^{n-1}\, x^{2n-1}}{(2n-1)!} \quad . . . . . \quad (2)$$

Use of the first three terms will give sufficient accuracy and permit an algebraic solution for r. The results of Eqs. 1 and 2 are combined in the equation,

$$r^4 - \frac{b^3 r^2}{6(b-a)} + \frac{b^5}{120(b-a)} = 0 \quad . . \quad (3)$$

Using the values, a=7.76 ft and b=7.85 ft, as in the author's example, gives 29.9 ft for the radius. There is, then, no need for Mr. Kagan's Table I.

SIDNEY L. GOLDBERG, F. ASCE

Oxnard, Calif.

Use of aluminum and timber in European structures

TO THE EDITOR: Mr. Greenfield's article (April issue, p. 44) throws significant light on the newer structural concepts now being developed in Europe. He has covered the ground adequately in the case of steel and concrete but has made no mention of aluminum and its alloys, which are being increasingly used all over Europe.

In Switzerland, where light alloys have been in use for the past 30 years, 22 percent of the aluminum produced in 1958 was employed for building purposes, window and facade elements playing a prominent part. In Italy the corresponding figure was 10 percent, in France 7 percent, and in Germany 9 percent.

Prefabricated aluminum wall paneling has been incorporated in a structure built 7,870 ft above sea level to house workers on the Grand Dixence Dam, Switzerland. In Swiss alpine areas aluminum is made use of for small culverts, tunnel linings, and avalanche fences.

In Milan, Italy, the Sarom and Pirelli buildings, each of 31 stories, have curtain-wall facades in natural aluminum. In Belgium, this metal has been used extensively in long-span structures, for example in the storage building at Antwerp Dock. This structure has a clear span of 260 ft and an overall length of 820 ft, with aluminum latticed purlins spanning between portal frames. The roof weight, including sheeting and stanchions, is only 2 lb per sq ft. In Germany light metal is being adopted wherever possible. The 4,350-sq meter surface of a winding tower at Osterfeld mine, Oberhausen, consists of 2,700 beveled sheets in an aluminum-magnesium alloy weighing some 28 tons. The same facing in half-inch brick clinker would have weighed 1,000 tons.

Laminated timber also claims many applications in Europe. Norway's traditional timber architecture is now being extended to bolted claw-plate-connectored and nailed, framed structures such as the grandstand next to Oslo's Holmenkollen ski jump, which accommodates 50,000 people. Nailed and glued construction is well exemplified in the demountable office buildings at the Zurich International Airport near Kloten. Dr. Kaempf's timber-girder construction is being used all over West Germany. These girders are 70 to 75 ft long; they are used for example in the Fronleichnam Church near Munich, built in the shape of a 70 by 75-ft ellipse.

Spain cannot be left out of this discussion. Her master builder and engineer designer, Eduardo Torroja, is responsible for some spectacular structures, such as the Esla River bridge, the Fronton Recoletos Sports Theater, and the Algeciras Market. [Señor Torroja, F. ASCE, died in June 1961.]

European practice is a remarkable mixture of architecture and engineering harmoniously blended with intuition to give exquisite proportions to all the structures being built there.

S. K. GHASWALA, F. ASCE
Chartered Engineer

Bombay, India

ASCE NEWS

Cities in the Year 1980—Annual Convention Theme

The growing role of the city in the American way of life—revealed in the 1960 federal census—underscores the importance of the program planned for the forthcoming Annual Convention of ASCE. What the American city will be like in the next two decades will be forecast in a series of papers to be presented at the Convention, which will be held in New York (at the Statler-Hilton), October 16-20. Gardner Reynolds is Convention chairman.

"Metropolis—1980" is the general Convention theme, and most of the 150 papers scheduled will relate to it. Thirteen of the Society's Technical Divisions are sponsoring 39 sessions. The City Planning Division will have a prominent place on the program, with two sessions by itself and joint meetings with the Highway and Air Transport Divisions. A timely Highway Division paper detailing plans for transporting people to the 1964 World's Fair will be given by Maj. Gen. W. E. Potter, executive vice-president of the fair corporation.

The Sanitary Engineering Division will sponsor four sessions, with air and water pollution the dominating interest. The Structural Division is sponsoring a research session, at which nine papers dealing with materials will be presented. It also is planning joint sessions with the Construction and Engineering Mechanics Divisions.

A battery of star luncheon speakers will cover facets of the same theme. They are Robert C. Weaver, Administrator of the Housing and Home Finance Agency, who will speak on "Urban Affairs," on Monday; ASCE Director Samuel S. Baxter, water commissioner and chief engineer of the Philadelphia Water Department, who will discuss "Utilities of the Future" on Tuesday; Austin J. Tobin, executive director of the Port of New York Authority, whose Wednesday luncheon talk will be on "Mass Transportation of People"; and Rex Whitton, Federal Highway Administrator, who will speak on "Urban Highways of the Future," on Thursday.

Field trips planned

Two interesting tours are planned. On Thursday afternoon, the Power Division will sponsor a trip to Consolidated Edison's atomic power plant, now nearing completion at Indian Point, N. Y., a short distance up the Hudson from the city. The Indian Point plant, the first atomic power station to be built in the metropolitan area, has a generating capacity of 275,000 kw and will provide electricity for a million people in the New York City-Westchester area.

Tuesday afternoon there will be a free boat trip around the harbor and metropolitan area waters, courtesy of the Port of New York Authority. This trip will be limited to 490—boat capacity. The trip will permit a passing view of pier redevelopment projects along the Manhattan and Brooklyn waterfronts, part of the Port Authority's long-range program for waterfront rehabilitation. Incidentally, some of the problems involved in the pier redevelopment program will be discussed in a Soil Mechanics and Foundations Engineering Division session.

Perhaps needless to say, New York has been the center of unprecedented construction activity in the past decade, and many important construction and reconstruction projects will be on view to the visiting engineers. Two of numerous outstanding projects currently under construction are the Lincoln Center cultural complex and the Pan-Am Building, which will be the largest commercial office building in the world.

Indian Point steam-electric-generating station, now under construction at Buchanan, N.Y., on the east bank of the Hudson, will be the objective of an Annual Convention tour sponsored by the Power Division. The station, shown here in aerial view, is being built by Consolidated Edison, without government subsidy, at a cost of $100 million. It is scheduled to begin operation this year. The reactor and boiler sections will be contained within the dome-shaped structure. The single center stack is for an oil-fired superheater, which will improve the efficiency of the steam produced in the reactor-boiler system.

UEC Open House planned

One of the highlights of this year's Annual Convention will be an Open House and inspection of the new United Engineering Center, to which ASCE—together with eighteen other engineering societies and groups—will move early in September. The Open House, set for Thursday evening, October 19, will be a gala enlivened with strolling musicians and refreshments. Visitors will be taken on guided tours of the building in small groups. The Chi Epsilon Conference Room will be dedicated during the Open House.

Enjoyable social program

The full social program traditional to Annual Convention week is also being planned. As usual the Metropolitan Section will be host, early Monday evening, to a "kick-off party"—actually a cocktail party aimed at breaking any possible ice. On Wednesday evening, the Section will again

pick up the tab for a cocktail party for those attending the dinner dance and reception for the new President and Honorary Members. There will be special entertainment during the evening too. Though there is no big planned event for Tuesday evening, some members may want to attend the annual dinner of the American Institute of Consulting Engineers. Others will want to seize the chance to enjoy the theater or other attractions of the city.

The ladies' week begins Sunday afternoon, when they will be guests of the Ladies' Committee for tea. Tuesday a special trip is planned to the home of President Theodore Roosevelt at Oyster Bay, once the summer White House. The traditional fashion show for the ladies is scheduled for Thursday morning.

Convention-week events will include the annual business meeting and the traditional Wednesday morning program, featuring the induction of ten new officers. G. Brooks Earnest, who will be installed as the new President, will address the session. As always, also, the program will include several meetings of the Department of Conditions of Practice. The Committee on Younger Members will sponsor one of these COP sessions, consisting of a panel discussion on "Professional Responsibilities of the Employer and the Employee to Each Other."

Special get-togethers during Convention week will include a number of annual engineering school alumni dinners and meetings. Cornell, Rutgers, the University of Illinois, Manhattan College, and Chi Epsilon have already announced their intention of having reunions, and there will also be a special Seabees dinner.

New York Convention Committee meets for one of many discussions of program for October Convention. Seated (left to right) are Robert W. Richards; ASCE Director Thomas J. Fratar; Otis D. Gouty, Assistant to the Secretary, ASCE; Gardner M. Reynolds, general Convention chairman; Carl A. Arenander, vice-chairman; and Malcolm Pirnie, Jr. Standing, in same order, are John H. Fisk, Assistant to the Secretary; John E. Robinson; J. Frank Brennan; Austin E. Brant; Martin S. Kapp; George A. Burpee, Jr.; Gordon Wallace; Don D. King, Assistant to the Secretary; and Stephen M. Olko.

Program in September issue

The complete program of technical and social events will be published in the September issue of CIVIL ENGINEERING.

EJC Reports on Soviet Engineering Achievements

Recent achievements and future goals of the Soviet Union in the field of engineering and engineering education and manpower utilization are presented in a report just released by Engineers Joint Council, Inc. Data indicate that the USSR annually graduates some 117,000 engineers, compared to 38,000 for the United States, and Soviet plans call for substantial increases in that number.

The report, entitled "The Training, Placement and Utilization of Engineers and Technicians in the Soviet Union," is based on a tour of the Soviet Union made last year by six representatives of U. S. engineering groups under sponsorship of Engineers Joint Council. Financial support was provided by the National Science Foundation and under an exchange agreement between the U. S. and the U.S.S.R. The 112-page printed report, including footnotes, statistical data and photographs, is available in limited supply for $1.00 from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

J. Waldo Smith Hydraulic Fellowship Awarded

John A. Hoopes, A.M. ASCE, of the Hydrodynamics Laboratory at the Massachusetts Institute of Technology, has been awarded the J. Waldo Smith Hydraulic Fellowship for the academic year, 1961-1962.

The fellowship provides a sum of $1,500 for research in the field of experimental hydraulics as distinguished from that of theoretical hydraulics. Mr. Hoopes proposes a study of the mechanisms governing the flow in the transition zone between wholly "laminar" and wholly "turbulent" flow in porous media.

The fellowship was established by the ASCE Board of Direction in 1938, with funds made available to the Society by the late J. Waldo Smith, former Vice President and Honorary Member. It is offered every third year, and runs for a full academic year. It provides the host institution with up to $500 for laboratory equipment connected with the research, plus the $1,500 stipend that goes to the winner.

Local Section Interest Invited in OCEA Contest

The help of ASCE's 79 Local Sections is sought in the third annual competition to select the "Outstanding Civil Engineering Achievement of the Year." While only national Directors of the Society are permitted to make nominations, Local Sections may make (indeed, are urged to make) recommendations to their respective Directors in this national competition. The deadline for nominations for the 1962 award is December 1.

The Outstanding Civil Engineering Achievement Award is made annually for any engineering project that falls into the general category of civil engineering. Only engineering and construction achievements within the confines of the 50 states are eligible. Judging is handled by a jury of engineering magazine editors. Selection of this jury is subject to confirmation by ASCE's Board of Direction.

Engineers' Role in World Affairs Stressed at ASEE Meeting

Over 3,000 engineering educators attending the 1961 annual meeting of the American Society for Engineering Education, held at the University of Kentucky, in Lexington, the last week in June, were told to "accept the responsibilities which the interdependence of nations have brought to your doorstep."

"As engineers, you and your students must take your fair share of the responsibility for the changes—political, economic, and social—which are taking place with such tremendous speed, since modern technology has been a contributing factor," Dr. Myer Cohen, director of operations for the United Nations Special Fund, told a banquet audience during the five-day convention. His remarks keynoted the theme of "Engineering and World Affairs," emphasized at every turn during the meeting, the largest in ASEE's history.

In the opening session, Dr. Eric A. Walker, president of the ASEE and of Pennsylvania State University, called on engineering educators to accept their international obligations: "Half the world is ill-fed, ill-housed, and ill-clothed. To eliminate these conditions is an engineering job for engineers. Can we in America's engineering colleges train 5,000 students who will work and sacrifice and so do something truly important for humanity—and do it with such skill and dedication that the rest of us can also be called professional men?"

In his presidential address at the opening session of the convention, Dr. Walker continued his challenge:

"We are living in what should be for engineers the most exciting period in history. There are important things to be done; society needs engineers and their talents more than it has needed them in any other period in history. This work will not be done by young engineering graduates oriented in their classes to look no further than a job of designing unnecessary fins for automobiles. For this we need young engineers with ideas, imagination, vision, idealism, and courage. And we need young engineering teachers who can inspire and encourage these ideas."

The key position of engineering educators in meeting these needs was emphasized by Dr. Cohen. But, he said, the problems are not simply solved. "The job," he declared, "requires a good deal more than technical know-how; it involves training, adapting, and inspiring. It requires a knowledge of psychology and anthropology, an intuitive ability to appreciate the folkways and mores of people having an outlook on life and daily habits totally different from ours."

Several educators agreed that agriculture and civil engineering, more than any other branches of applied science, hold the key to American assistance to underdeveloped nations. Doedi Soemawidjaja, educational and cultural attaché in the Indonesian Embassy in Washington, confirmed the emphasis on practical technology: "We are fully aware that the skill and ability to exploit wealth must be attained through specialized education, particularly engineering education at the university level."

American universities can also make major contributions to our international relations through training of foreign students on our own campuses and through training and assistance programs organized overseas. Dr. Ralph W. Ruffner, director of the Office of Educational Service in the International Cooperation Administration, told members of the ASEE that international development programs sponsored by the United States will make increasing demands on universities for help on an increasingly wide variety of problems. Education, he said, is seen as "the primary tool for the development of human resources." Increasingly, foreign countries are asking for help in expanding and redirecting their educational systems.

Problems of teaching foreign students in the United States were reviewed at a number of sessions, and the unanimous conclusion was one of uncertainty. Students from underdeveloped countries studying in most American engineering colleges become proficient in subjects at the frontiers of engineering science, but they may not find outlets for these new talents in their own countries struggling with basic problems of industrialization and the use of natural resources. Dean Kurt F. Wendt, of the University of Wisconsin, suggested an internship program for foreign students to give them practical experience in American industry. And Dean Fred H. Pumphrey, of Auburn University, said that in his experience foreign students also wanted special classes in the cultural, religious, and social backgrounds of American life. It was the consensus that "there can be no project more important than the education and guidance of young foreign engineers who are being courted by the Communists."

During the meeting the ASEE announced receipt of a $47,250 grant from the National Science Foundation for the nation's first critical evaluation of two-year technical institute programs, to be completed during the next twelve months. Another NSF grant of $24,000 will provide continued support for the ASEE's "visiting engineer program," which has been signally successful in encouraging and promoting careers in engineering among young college students.

At the close of the meeting Dr. Robert W. Van Houten, F. ASCE, president of the Newark College of Engineering, took office as president of the ASEE. Also installed were George A. Marston, F. ASCE, and Curtis L. Wilson, as vice-presidents, and Wendel W. Burton as treasurer.

ASCE Overseas Unit Formed in France

ASCE members living in France have formed an Overseas Unit, the second to be organized under a policy recently adopted by the Board of Direction. An organizational meeting will be held in Paris later in the summer, with Dr. Shaul C. Schiff, A.M. ASCE, presiding. All interested engineers living abroad and desirous of attending the meeting should get in touch with Dr. Schiff at 25 Blvd. Bonne Nouvelle, Paris 2, France.

It is expected that Overseas Units will provide an opportunity for ASCE members living abroad to get together for technical and social programs in areas not served by the Society's Local Sections. ASCE will act upon petitions for formation of such units from members in foreign countries, after clearing the proposed unit with local civil engineering societies in the country involved.

The Society's first Overseas Unit was formed in Australia late in 1960. Members interested in affiliation with the Australian Overseas Unit may obtain information from J. A. Saftich, Secretary, P. O. Box 17, Milsow's Point, N.S.W., Australia.

Amended Code of Ethics Ratified by Members

The Society's amended Code of Ethics has been ratified by a 12,599 to 528 vote of the membership. Ballots were counted and the official results announced by the tellers on July 20. A total of 13,264 ballots was counted, of which 137 were blank.

Mail ballots had been sent to the entire membership on May 10. These were accompanied by the "existing" and "proposed" Codes as well as an interpretive "Guide" prepared by the ASCE Committee on Professional Practice. Voting was on the amended Code only. Ratification required a majority of all members voting.

The amended Code of Ethics, a copy of the old Code with changes interlineated, and the entire "Guide to Professional Practice Under the Code of Ethics" were published in the June 1961 issue of CIVIL ENGINEERING.

Unlike the Code itself, the interpretive Guide may be amended by action of the Board of Direction. Amendments to the Code require a two-thirds vote by the Board of Direction, and ratification by the membership.

Alfred Noble Prize Goes To Mechanical Engineer

George S. Reichenbach, on the staff of the Mechanical Engineering Department at Massachusetts Institute of Technology, has been named recipient of the Alfred Noble Prize, a joint award of the original four Founder Societies and the Western Society of Engineers.

The prize, consisting of a cash award and certificate, is awarded annually to the young author of a technical paper of exceptional merit that has been published by any one of the five participating engineering societies. Mr. Reichenbach's paper, "The Importance of Spinning Friction in Thrust-Carrying Ball Bearings," was published by the *Journal of Basic Engineering* of the American Society of Mechanical Engineers, of which he is a member.

The Alfred Noble Prize was established in 1929 with a fund contributed by engineers and others in honor of the late Alfred Noble, Past President of both the American Society of Civil Engineers and the Western Society of Engineers.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.38	1.38
Baltimore	1.16	1.14
Boston	1.26	1.23
Chicago	1.44	1.50
Denver	1.32	1.25
Houston	1.31	1.26
Kansas City, Mo.	1.26	1.19
Los Angeles	1.36	1.35
Miami	1.38	1.38
New Orleans	1.25	1.22
New York	1.30	1.29
Pittsburgh	1.11	1.07
Portland, Oregon	1.31	1.28
San Francisco	1.38	1.35
Seattle	1.13	1.13

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	1.03	1.03
II, Mid Atlantic	1.18	1.15
III, Mid West	1.32	1.26
IV, South	1.12	1.12
V, West	1.16	1.13
VI, Far West	1.20	1.16

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was June 30, 1961.

ASCE Prizes and Awards Announced by Board

On recommendation of the ASCE Committee on Prizes, the Board of Direction has approved the following awards for papers published in Volume 125 (1960) of Transactions and in CIVIL ENGINEERING. The prizes will be presented during the Society's Annual Convention, to be held in New York City this October. Brief biographies and photos of the winners are scheduled for the October issue.

Norman Medal

LORENZ G. STRAUB, F. ASCE, and ALVIN G. ANDERSON, M. ASCE, for Paper, "Self-Aerated Flow in Open Channels."

J. James R. Croes Medal

GEORGE WINTER, F. ASCE, for Paper, "Lateral Bracing of Columns and Beams."

Thomas Fitch Rowland Prize

H. BOLTON SEED, M. ASCE, ROBERT L. MCNEILL, A. M. ASCE, and JACQUES DE GUENIN, for Paper, "Clay Strength Increase Caused by Repeated Loading."

James Laurie Prize

J. BARRY COOKE, F. ASCE, for Paper, "Rockfill Dams: Wishon and Courtright Concrete Face Dams."

Arthur M. Wellington Prize

T. WILLIAM LAMBE, F. ASCE, for Paper, "Compacted Clay: Engineering Behavior."

Collingwood Prize

SIDNEY A. GURALNICK, M. ASCE, for Paper, "Strength of Reinforced Concrete Beams."

On recommendation of the Technical Divisions, the Board has approved the following awards:

Construction Engineering Prize

GAIL KNIGHT for Paper, "Concreting the West Delaware Tunnel," CIVIL ENGINEERING, December 1960.

Rudolph Hering Medal

A. L. THOLIN, F. ASCE, and CLINT J. KEIFER, M. ASCE, for Paper, "Hydrology of Urban Runoff."

Karl Emil Hilgard Hydraulic Prize

HUNTER ROUSE, F. ASCE, TIEN TO SIAO, and S. NAGARATNAM, A.M. ASCE, for Paper, "Turbulence Characteristics of the Hydraulic Jump."

Thomas A. Middlebrooks Award

I. C. STEELE and J. BARRY COOKE, Fellows ASCE, for Paper, "Salt Springs and Lower Bear River Concrete Face Dams."

Moisseiff Award

JOHN A. BLUME, F. ASCE, for Paper, "Structural Dynamics in Earthquake-Resistant Design."

Rickey Medal

TORALD MUNDAL, F. ASCE, for Paper, "Rockfill Dams: Brownlee Sloping Core Dam."

J. C. Stevens Award

DARYL B. SIMONS, M. ASCE, and EVERETT V. RICHARDSON, A.M. ASCE, for discussion of Paper, "Resistance Properties of Sediment-Laden Streams."

Theodore von Karman Medal

R. D. MINDLIN, M. ASCE "in recognition of distinguished achievement in engineering mechanics."

On recommendation of the Ernest E. Howard Award Committee, the Board also approved the following award:

Ernest E. Howard Award

HERSCHEL H. ALLEN, F. ASCE, "for the definite contributions he has made to the advancement of structural engineering, with special reference to the 'Potomac-type' bridge piers which he developed."

Papers Invited for Applied Mechanics Congress

Though the dates set for the Fourth U. S. National Congress on Applied Mechanics—June 18-21, 1962—seem far in the future, the deadline for submitting papers is considerably earlier, January 1, 1962. In fact, to avoid delay and confusion in the review and selection of papers, authors are urged to submit their manuscripts well ahead of the deadline.

All research workers in the field are cordially invited to submit papers dealing with original experimental or theoretical contributions to applied mechanics. The scope is wide, including mechanics of rigid bodies and deformable solids, mechanics of fluids and gases, thermodynamics and heat transfer. It is expected that all Congress papers will be published in full in the Congress Proceedings.

Manuscripts—including text, equations, tables, and figures—must not exceed the equivalent of 5,000 words. They should be submitted in duplicate. However, it is requested that the first page of each manuscript—containing only the title of the paper, the name and affiliation of the author, and an abstract of not more than 100 words—be submitted in triplicate. The abstracts of accepted papers will be published in the June 1962 issue of the Journal of Applied Mechanics. References should be grouped in a bibliography at the end of the manuscript and should list author, title, publication or publisher, volume, year, and page, in that order. Text references to the bibliography should be made by numbers in brackets, references to equations by numbers in parentheses.

Papers should be addressed to R. M. Rosenberg, Chairman, Editorial Committee, Fourth Applied Mechanics Congress, University of California, Berkeley 4, Calif.

The Applied Mechanics Congresses—held every fourth year under the auspices of the U. S. National Committee on Theoretical and Applied Mechanics—is intended to supplement the international congresses in the field. ASCE is one of the cooperating groups represented on the national committee. The others are the American Institute of Chemical Engineers, the American Mathematical Society, the American Physical Society, the American Society of Mechanical Engineers, the Institute of the Aerospace Sciences, and the Society of Experimental Stress Analysis. The forthcoming (June 1962) Congress will be held at the University of California, Berkeley 4, Calif. General inquiries about the Congress should be addressed to Congress Secretary W. Goldsmith at the University of California.

Volume Contains Papers On Stilling Basins

Proceedings Symposium No. 5 has been prepared in answer to requests to make available in one volume the series of papers on Stilling Basins and Energy Dissipators appearing in the Journal of the Hydraulics Division. Copies may be ordered from the Executive Secretary of the Society.

The 312-page paperbound volume contains eight informative papers, plus all the discussion. It is available at a price of $6.00, with the usual 5 percent discount to Society members and to public and school libraries.

NEW ADDRESS

After September 5, 1961, ASCE and CIVIL ENGINEERING will be in new offices in the UNITED ENGINEERING CENTER. The new address is:

American Society of Civil Engineers
United Engineering Center
345 East 47th Street
New York 17, N. Y.
Telephone: PLaza 2-6800

LOCAL SECTION MEETINGS

Arizona—Arizona Regional Meeting held jointly with the American Congress of Surveying and Mapping at the Westward Ho Hotel, Phoenix, October 18-21.

Massachusetts—Two summer luncheon meetings at the Hotel Lenox, Boston, on August 16 and September 21, at 12:15 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

St. Louis—Regular monthly luncheon meetings at the York Hotel on the fourth Monday of each month, at 12:15 p.m.

Tennessee Valley—Annual meeting in Knoxville, November 3 and 4.

Texas—Fall meeting in Austin, October, 5-7.

TECHNICAL DIVISION MEETINGS

HYDRAULICS DIVISION CONFERENCE

Urbana, Ill.
University of Illinois
August 16-18, 1961
Sponsored by
Hydraulics Division

WEST COAST CONFERENCE OF APPLIED MECHANICS

Seattle, Wash.
University of Washington
August 28-30, 1961
Co-sponsors
Engineering Mechanics Division
ASME

CONFERENCE ON FUNDAMENTAL RESEARCH IN PLAIN CONCRETE

Monticello, Ill.
University of Illinois
September 5 and 6, 1961
Co-sponsor
Structural Division

AMERICAN ASSOCIATION OF PORT AUTHORITIES CONVENTION

Long Beach, Calif.
September 25-29, 1961
Sponsored by
Waterways & Harbors Division

ASCE CONVENTIONS

ANNUAL CONVENTION

New York, N. Y.
Hotel Statler
October 16-20, 1961

HOUSTON CONVENTION

Houston, Tex.
Hotel Shamrock Hilton
February 19-23, 1962

OMAHA CONVENTION

Omaha, Nebr.
Hotel Sheraton-Fontenelle
May 14-18, 1962

DISTRICT CONFERENCES

DISTRICT 9 COUNCIL

Mammoth Cave, Ky.
September 9 and 10, 1961

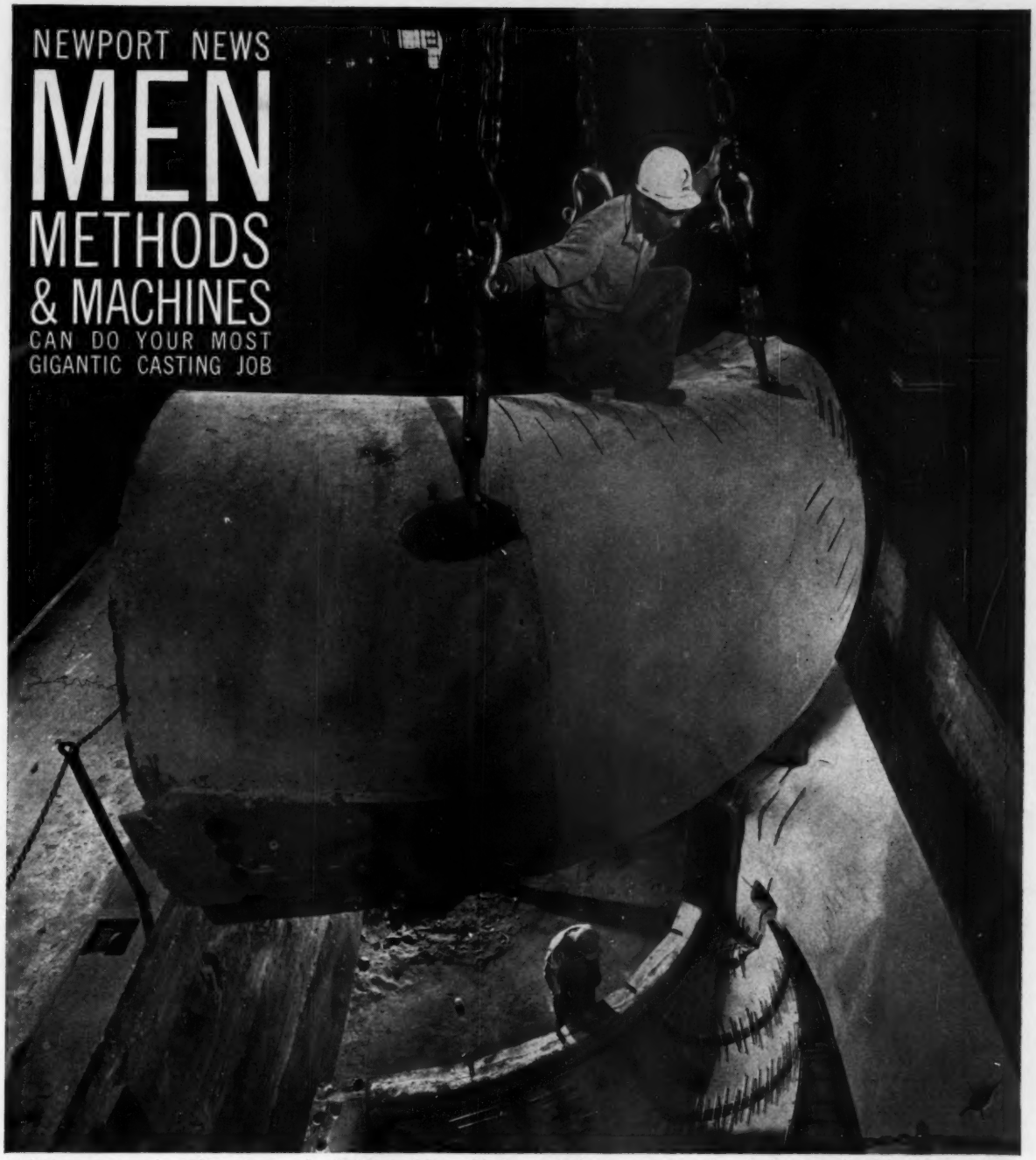
DISTRICT 4 COUNCIL

Harrisburg, Pa.
October 7, 1961

NEWPORT NEWS

MEN METHODS & MACHINES

CAN DO YOUR MOST GIGANTIC CASTING JOB



Mold for a section of a turbine stay ring for the Hartwell Power Plant. It is the largest one-piece Y-casting ever produced by Newport News.

It takes all three—men, methods and machines to tackle a job as big as this one! Newport News has completed many of them including six hydraulic turbines for the Niagara Project, four for the Hartwell Power Plant, and many others.

Newport News not only cast this giant unit but also milled it—and built the boring mill that did the work! No challenge is too great.

The secret of its leadership in the fabrication of heavy equipment is its staff of highly trained engineers and technicians, thousands of skilled workmen and 225 acre plant capable of turning out such projects as hydraulic turbines and valves, vacuum or pressure vessels for the petrochemical industry, bridge caissons, wind tunnels, and pulp and paper equipment.

Consult Newport News for preliminary recommendations at no obligation.

Newport News
SHIPBUILDING AND DRY DOCK CO.
NEWPORT NEWS, VIRGINIA

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Highlight of the annual joint dinner meeting of the Rhode Island Section and the University of Rhode Island Student Chapter was installation of officers for the forthcoming year. Reading from left to right are Philip S. Mancini, Jr., treasurer; Allen B. Schwartz, secretary; Angelo A. Marcello, president; and Francis C. Pierce, vice president. Appropriately enough the agenda also included presentation of the Charles A. Maguire Prize Award for their student papers to Harvey A. Heffner, of Brown University, and Robert A. Greig, of the University of Rhode Island. Professor Clarence E. Miller, chairman of the Geology Department at the University of Rhode Island, spoke on the provocative title "Blame It On the Glacier."

On May 29, the Panama Section conducted a very successful tour of Cemento Panama, one of Central America's principal suppliers of cement. The turn out was excellent and included many distinguished guests from the Republic and the Canal Zone. During a respite Panama Section President Thomas G. Duque (far right) posed, in usual order, with Roberto Lopez Fabrega, promotion and sales manager of Cemento Panama; Agustin Alberto Arias, general manager of Cemento Panama; Lt. Col. Robert D. Brown, Jr., F. ASCE, engineering and construction director of the Panama Canal Company; and Augusto S. Boyd, president of Cemento Panama. The hospitality of the cement company included a magnificent buffet dinner.

Present at a recent dinner meeting of the **Juneau Branch** of the **Alaska Section** were 49 Section members and seven students of the Juneau-Douglas High School, this year's potential crop of college students interested in engineering. The section has held open house for teenagers annually for several years in order to familiarize students with the engineering profession. Raymond Archibald, chief bridge engineer of the State of Alaska and for many years active in the administrative and technical committees of the Structural Division, presented an informal discussion of the Technical Divisions.

Horace W. Harding, manager of research and development for the Kansas City Chamber of Commerce, spoke at the regular May meeting to 150 members of the **Kansas City Section** on "The Metropolis Against Itself." Mr. Harding vividly outlined the creeping disaster that may engulf our large cities if they do not take constructive action to combat the devisive forces caused by the many and conflicting units of government. A case in point is Kansas City itself, with 69 municipalities in the urban area and each one with taxing and governmental powers. The topic was of particular future significance to the 30 civil engineering students from Kansas University, who were guests of the local section.

The **South Carolina Section** held its state meeting in Charleston on May 12 and 13. The first day consisted of a harbor cruise to Fort Sumter followed that evening by a social and banquet. But early Saturday morning the technical sessions, which featured speakers from the South Carolina State Ports Authority and from the Polaris Missile Base, convened. Larry A. Safford, manager of Services of the Naval Weapons Annex for the Lockheed Aircraft Corporation, presented a résumé of Lockheed's role in the overall space program. It is his contention that "The almost daily headlines fail to convey the very solid progress we are making," and that we are further along in the overall military and civilian space effort than is realized. Most exciting are the prospects in the commercial field. For instance, Lockheed "is considering a joint venture with two major communications companies to operate a world-wide communications network." Current thought is that three satellites could provide 1,000 phone circuits or their equivalent covering the entire earth. Another guest speaker, James J. Scott, Jr., chief engineer of the South Carolina Port Authority, spoke on "The $21,000,000 Ports Expansion Program," which is in the final stage of construction.

ON GUARD IN INDEPENDENCE SQUARE

About 75 feet away from Independence Hall, in the park to the south, stand R. D. Wood Hydrants like sentinels on duty. While their proximity to the Nation's most revered historic monument does not necessarily imply endorsement, we nevertheless like to think of them there, on guard night and day against the fire that could destroy what Gen. Howe saw fit to spare, and Clinton too, in the British occupation. But R. D. Wood Hydrants need no endorsement. For over a century they have shown themselves to be in constant readiness for any emergency. Of simple, ingenious design and rugged construction, R. D. Wood Hydrants are protected against ice and sediment—function smoothly when the engines arrive. There could be no better protection for any community than R. D. Wood Hydrants—and there could be no better protection for the birthplace of the U.S.A.

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R. D. WOOD COMPANY

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Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds)

American Steel and Wire
Division of
United States Steel

ONE

There's only one way to rebuild a city right. Start from the streets up. If you're involved with urban redevelopment, you're playing for keeps because the costs are enormous and must be financed over a long period. You can't afford to have public works deteriorate before they're paid for, including city streets. Keep this in mind: the longest-lasting streets are reinforced with welded wire fabric.

Concrete pavement slabs are the prey of variations in temperature, moisture, soil movement and traffic. Concrete provides the necessary compressive strength to combat cracks, but lacks tensile strength. Steel welded wire fabric delivers the tensile strength needed to prevent progressive opening of cracks and to safeguard the slab's load-carry-

ing capacity. Streets that are reinforced with welded wire fabric have a balanced design that protects edges and corners. Load is distributed evenly throughout the slab and stresses are reduced 30%.

USS American Welded Wire Fabric is your best way of making sure your streets will still be safe and smooth years from now. It is precision-made from cold drawn, 60,000 psi minimum yield strength steel wire to your exact size and style requirements, ready for immediate placement. For full information about USS American Welded Wire Fabric, or for technical assistance, write American Steel and Wire, Dept. 1210, Rockefeller Building, Cleveland 13, Ohio.

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THE YOUNGER VIEWPOINT

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	William R. Walker 4600 Franklin Ave. Western Springs, Ill.	Judd Hull 6000 S. Boyle Ave. Vernon, Calif.

This month's editor is Donald Kowtko, committee representative for Zone I.

"Young" need not be only a reference to physical age. Youthful ideas may be found in people—in this case, engineers—of all ages. The following "young" ideas were submitted by a Member of ASCE, Alfred G. Graves, of Westfield, N. J., who writes on the problems that face the civil engineering profession today.

What's happening to civil engineering?

"Whatever is happening to civil engineering is also happening to civil engineers since the two, of course, cannot be separated. Then let's think through what is happening to civil engineers and our profession.

"It is a fact that many of the civil engineering colleges are crying for students. But why are the technically bent high-school and college students steering clear of civil engineering as a career? Has civil engineering lost its glamour—its challenge—its intrigue? When we consider that civil engineering is the hub from which all the 'spokes' of the various fields of engineering radiate and the center around which all fields of science revolve, this becomes a serious problem."

What really is the problem?

"Some may say that civil engineering is tame compared to space science, atomics, and electronics! However, if we, as civil engineers, think of our basic knowledge and skills as the hub from which the other engineering professions have sprung, in reality it is civil engineering that is leading the way in the space age! It is my opinion that we have accepted a role far beneath and inconsistent with our true value and potential in the world of science and industry. It may well be that we have the wrong attitude. Have we collectively accepted the role of 'subcontractor' to the architect—'subcontractor' and technical assistant to the builder? If so, we must do something to correct these wrong impressions and attitudes."

The key to the problem

"Considering the total number of civil engineers, it is my opinion that there is a scarcity of those who create positively and sell their ideas. To me, this is the key to the problem—positive creativeness *and* the ability to sell one's ideas. This is certainly not a new thought, but one worth thinking about again. Collectively we are allowing our profession to shrink and wither. Could it be that this is happening because we, as individual members of this vital profession, have ceased to think creatively and refused to sell our ideas?

"Are the civil engineering colleges teaching the 'new crop' of civil engineers to think creatively? Are they teaching them how to sell their ideas—the products of their technically trained and skilled minds? The future and possibly the very survival of our society may depend upon the future of our profession and present-day civil engineers."

Do it yourself

"Should we depend solely upon civil engineering colleges to turn out better civil engineers in the future and can civil engineering afford to wait for such individuals to mature professionally? What about us—the 'present-day' civil engineers? Must we wait to be helped when we can help ourselves? We have the network of and for communication on these matters—right here in our own Society (the various Technical Divisions and Local Sections).

"Who can honestly say that civil engineering has lost its glamour, its challenge, its intrigue? Is this only the 'Younger Viewpoint'?"

"The Younger Viewpoint" agrees that if civil engineering is to maintain (or regain) its position as the hub of the engineering profession, we must think more creatively, communicate more effectively, and be prepared to go to bat for our profession individually and collectively. The American Society of Civil Engineers sponsors dozens of programs, both technical and professional in nature, to encourage the growth of and strengthen the prestige of civil engineering as a profession. Your active support of ASCE policies and programs can go a long way toward giving your profession the "lift-off" that it needs in the space age.

Unions not for engineers

The following letter was received from R. Alan Berggren, A.M. ASCE, Oak Park, Ill.:

"The May 'Younger Viewpoint' column asked for thoughts on the subject of unionism for engineers. For your consideration, here are mine.

"First, I believe that true unionism and true professionalism cannot both exist in the same individual. Professionalism requires an individual to rely upon his intelligence, ability, and initiative for advancement within his profession, while unionism requires only seniority and the faithful payment of dues. Individuals are just not made with both these traits.

"Second, those engineers who favor unionism are generally those with technicians' initiative, preferring the repetitive, unimaginative positions available in any large engineering office. The others feel that advancement to the management level can only be accomplished on an individual basis, unionism acting as a deterrent.

"Last, the struggle for professional recognition of engineers is taking one step backward for unionism's every step forward. Laymen ask the question, 'Who ever heard of a Doctor or Lawyer joining a union?' These gentlemen are true professionals. Are we?"

Wanted—your opinions

Remember "The Younger Viewpoint" is your opportunity to exchange ideas and communicate with civil engineers across the nation. Send your letters to any of the engineers listed on our "Younger Viewpoint" masthead.

Papers From Cohesive Soils Conference

Availability of the papers presented at the ASCE Research Conference on Shear Strength of Cohesive Soils, held at the University of Colorado in June 1960, is announced. The proceedings, published in a single hard-bound cloth volume, include the Foreword, Conference Program, Photographic Report, Opening Address, and all 26 Conference Papers. Also included are the written discussions and closures; reports by the moderators of panel sessions; and a Table of Contents, Subject Index, and Index of Authors and Discussers.

The list price for this volume is $10.00 per copy, with no discounts available. To facilitate ordering, a coupon has been provided on page 119.

Total Membership as of July 12, 1961

Honorary Members	50
Fellows	11,128
Members	16,871
Associate Members	19,509
Affiliate Members	120
Total	47,678
(July 8, 1960	45,810)

ALPHA news and notes from the field

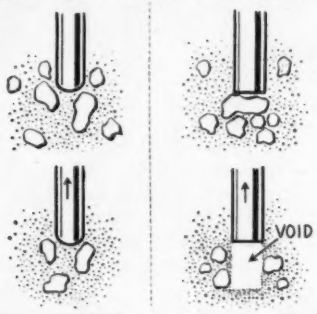
BETTER CONSTRUCTION THROUGH BETTER USE OF CEMENTS

Test Cylinders Made Right—Give Right Answers

The concrete test cylinder is the most commonly used test for concrete strength. It is a reliable test *only* if made according to standard procedure, which has been outlined in a previous issue of Alpha's "News and Notes From The Field." Now, let's take the negative approach and list the main factors that can cause your concrete test cylinders to give you the *wrong* results.

1. Not Using Proper Rods

A ⅜" rod with a hemispherical tip does the job best and is the only rod recommended. Do not use a piece of reinforcing steel just because it's handy.



The hemispherical-nose rod is best because it slides over the aggregates instead of pushing them. When it is withdrawn, concrete closes smoothly after it.

A flat-nose rod is inefficient because it cannot slip through the aggregates, but forces them downward, and gives the same effect as segregation. A flat-nose rod also is apt to leave voids as it is withdrawn as shown above at right.

2. Incorrect Sampling

A sample should be obtained from at least 3 parts of the load, and taken directly from the truck or mixer discharge. Before filling the molds, the individual portions of the sample should be thoroughly re-mixed in a large flat pan, wheelbarrow or on some clean, non-absorptive surface.

3. Insufficient Rodding

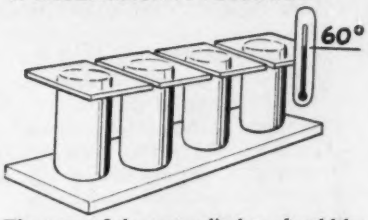
Fill each mold ⅓ full of the concrete sample and rod each a total of 25 times, over the entire surface.

Fill each mold ⅔ full and rod each 25 times, over the entire surface, being careful not to extend rod deeply into lower layer.

Overfill cylinder slightly and rod top layer 25 times. Penetrate but do not go through second layer. Rod evenly over entire surface.

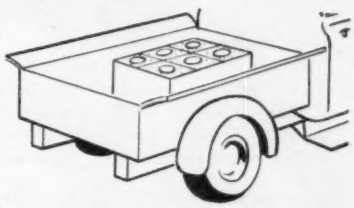
To close any voids left by rodding, tap cylinders lightly all around. After the top layer has been rodded, the surface of the concrete should be struck off with a trowel.

4. Insufficient Protection



The tops of the test cylinders should be covered with glass plates, oiled paper, wet burlap or a similar material to prevent the loss of moisture. Store cylinders where the temperature stays between 60°F. and 80°F. When cylinders are ignored for several days at higher or lower temperatures, results will be erratic. After casting, cylinders should be left undisturbed for 24 hours until they can withstand handling.

5. Careless Handling and Curing



Test cylinders should not be subject to any movement or vibration for a period of 24 hours. They are then placed in curing box for moist curing at 70° or transferred to a laboratory curing room. Test cylinders can still suffer considerable damage if they are not carefully packed or cushioned for transit.

Reprints of this information may be had at no cost. For technical assistance in making and checking cylinder tests, contact the Alpha representative in your area.

ALPHA
PORTLAND CEMENT COMPANY
Alpha Building, Easton, Pa.

BY-LINE WASHINGTON . . . . .

The engineering profession—and the construction industry—took some considerable ups and downs in Washington, as the pace there continued to quicken visibly. On balance, there was more up than down, but the down side was extremely serious from the viewpoint of the standing of the profession.

To get to good news first, here's a listing of "ups": Passage of the huge ($4.9 billion or $9 billion—depending on how long a view you take) housing bill, which puts heavy emphasis on planning activities; okay of financing programs that appear to assure orderly completion of federal-aid work; agreement on taking stream-pollution work out of the hands of the Public Health Service (presumably in favor of an engineering approach); strong backing for increased spending on engineering (and other scientific regimen) schools and on research from the National Science Foundation; various appropriations for increase of engineering activity in many areas of the federal government establishment.

Possibly most significant is the housing bill. The bill has been attacked as a "monstrosity" and defended as "moderate," and it has a number of, at least, questionable provisions—one is the long-term, virtually no-down-payment mortgage provision. However, the bill places heavy emphasis on urban and transit planning of all types; provides also for long-range community development planning (via money to purchase "open spaces" for parks); and lends encouragement to construction of mass-housing units, both for the elderly and for so-called middle-income groups, plus providing for 100,000 new public housing units.

On the housing bill, don't count on fast action. A quick survey of housing agencies in Washington indicates it will be more than a year before much money gets into circulation.

* * *

The stream pollution bill, as adopted by the House-Senate conference committee, will mean more immediate funds: $80 million for Fiscal Year 1962, $90 million for Fiscal Year 1963, and then $100 million for fiscal years through 1967. Tucked away in the various appropriations bills (other than the big construction measures for Army Civil Works and Public Works contruction), were such items as: $8 million for the Geological Survey, to continue its hydrological programs with local sponsors; $53 million for the Soil Conservation Service for its small-watershed-protection program; $70 million for the Veterans Administration for new hospital construction; $535 million for the General Services Administration—in part to pay for 21 new federal buildings already approved by Congress; $139 million for construction work for the National Aeronautics and Space Agency.

* * *

On the "down" side there were two developments of major concern: The disclosures of corruption and incredibly bad performance of engineering work on New Mexico highway construction; and the serious criticisms of the Navy and of consulting engineers for the collapse of Radar Tower No. 4, in the Atlantic Ocean last January.

The highway-investigation disclosures were probably more shocking because of the matter-of-fact, business-as-usual way in which flagrant disregard for public funds, engineering specifications, even the most elementary inspection procedures seemed to have been conducted in New Mexico. And they indicated that corruption extended through the state's engineering forces to a considerable degree.

The investigations had several immediate effects, none of them complimentary to engineers: In the appropriations for the Department of Commerce, Congress included $1.5 million for employment of additional auditors and engineers, so that the Bureau of Public Roads could scrutinize state operations more closely; BPR chopped off all funds for New Mexico until it could come up with an acceptable plan for inspection and operation, blacklisted nine contractors and eight employees of the highway department; the Justice Department "recommended" that the state take action to recover funds paid a contractor for a four-mile stretch of highway that was breaking up even while it was being accepted for final payment.

But perhaps the most important effect is to cast a cloud over the engineering competence of BPR, whose area and district engineers—relying on state reports—had approved the New Mexico road; and on the engineering and inspection staffs of every other state highway department. In fact, the House subcommittee counsel told reporters that he could "throw a dart any place on the map of the United States and come up with evidence of corruption in the highway program."

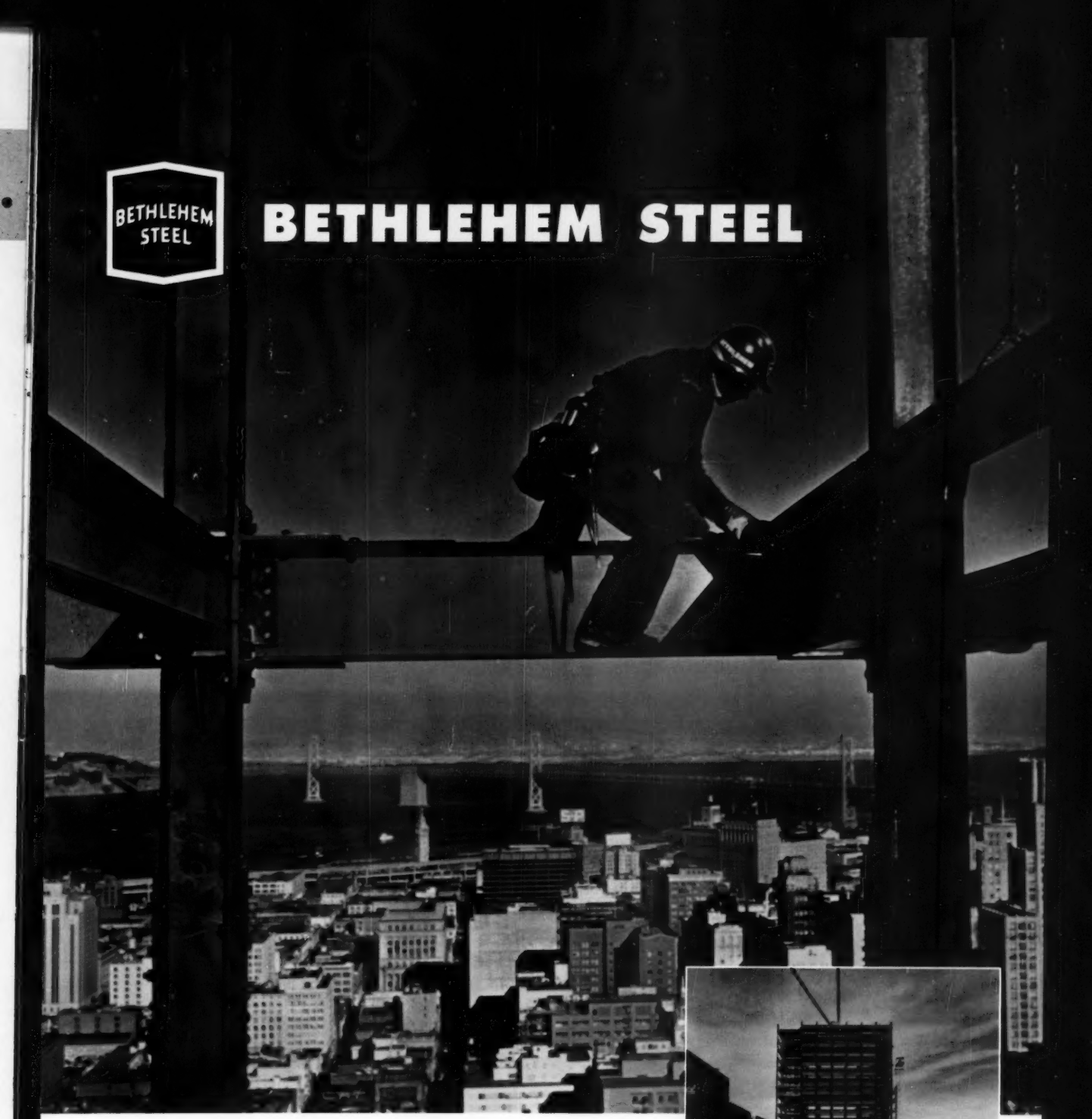
The second serious blow was the report of a Subcommittee on Preparedness of the Senate Armed Services Committee. After two weeks of carefully conducted hearings, the Subcommittee report blamed the Navy's Bureau of Yards and Docks, and its consulting engineers—for accepting an "untried" system of erection of the tower legs, for not taking positive action when the tower legs were injured during erection, for hiring the same consultants to inspect their own work after the tower's instability had been established. Again, the effect was to criticize the engineering capability of one of the government's most experienced organizations, and also that of a top-ranking consulting firm.

* * *

The long fight by waterways interests against lowering bridge heights over navigable waterways was half won in mid-July. The House approved legislation setting vertical clearances on the Upper Mississippi at not less than 55 ft above river levels reached 98 percent of the time, or not less than 63.7 ft above normal pool stage—whichever is greater. At the same time the bill sets minimum vertical clearance of bridges crossing the Sacramento River in California at 60 ft above project flood plane, upstream from Sacramento to Chico Landing. Highway officials have long sought to lower vertical heights, on the ground that higher bridges constitute a subsidy to the waterways by highway users. However, Rep. Frank E. Smith (D. Miss.) who sponsored the legislation, said that total added costs, on bridges built over the Mississippi during the next 50 years would be only a little over $3 million.

BETHLEHEM STEEL

BETHLEHEM STEEL



TOWER OVERLOOKS SAN FRANCISCO BAY.

This 29-story tower addition makes the Fairmont San Francisco's tallest hotel. To be ready for occupancy in 1962, the earthquake-resistant steel structure is connected with Bethlehem high-strength bolts. Bethlehem fabricated and erected the 3,089 tons of steelwork.

The 7-story base of the Fairmont Hotel's addition will contain a 200-car garage, a convention-exhibit hall, and, at lobby level, a dance pavilion and garden area.

Steel

for Strength
. . . Economy
. . . Versatility

Architect: Mario Gaidano; *Structural engineer:* H. J. Brunnier; *General contractor:* Haas and Haynie Corporation

BETHLEHEM STEEL

Architect: Stone, Marraccini and Patterson; *Associate architect*: Foss, Olsen and Sands; *Consultant*: Alston G. Gutterson; *Structural engineer*: John H. Stevenson; *General contractor*: Lease Company, Inc.; *Fabrication and erection*: Bethlehem Steel

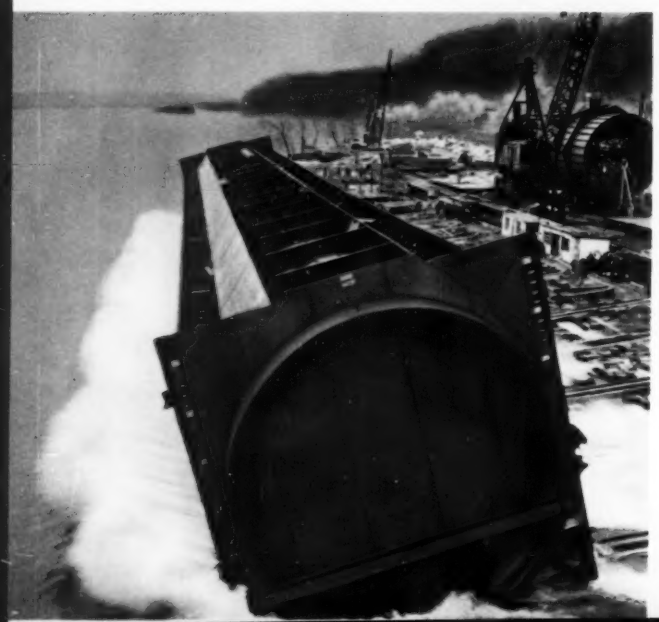
ALASKAN HOSPITAL STEELWORK ERECTED IN 4 WEEKS.

The 608-ton steel frame for this $5½-million state mental hospital at Anchorage had to go up fast . . . and it did. Steel framing will also make it easy to add floors when the hospital's 225-bed capacity can be doubled.

MAN-MADE "CANYON" OF STEEL SHEET PILING.

Within three years, ocean-going vessels will steam up a 43-mile-long, deepwater channel from San Francisco Bay to Sacramento. At the right, in this view, is a portion of one of two 400-ft-long approach guide walls for California's first navigational locks. The "canyon" walls are formed by Bethlehem steel sheet piling. The locks, located near Sacramento, are a section of a barge canal to connect the deepwater channel with the Sacramento River.

Design, engineering and supervision of construction: U.S. Army Corps of Engineers; *Contractors*: Lock-Bridge Constructors, a joint venture of Rothschild, Raffin and Weirick, Inc., Yuba Consolidated Industries, Inc., and George Pollock Co.



TUNNEL BEGINS 200-MILE TRIP.

This 305-ft-long steel segment is one of twelve being fabricated at Port Deposit, Md., for a two-lane vehicular tunnel to be laid in a trench on the bottom of the Elizabeth River, connecting Norfolk and Portsmouth, Va. Each segment consists of ten 33-ft-diam joined assemblies totalling nearly 600 tons of steel, much of it steel plate supplied by Bethlehem. Each segment is launched into the Susquehanna River and towed 200 miles to the job site where it is sunk into position.

Owner: Elizabeth River Tunnel District of Norfolk; *Designer and supervisor of construction*: Parsons, Brinckerhoff, Quade and Douglas; *Prime contractor*: Diamond Construction Co.; *Fabricator*: Wiley Manufacturing Co., subsidiary of Republic Industrial Corp.

for Strength
. . . Economy
. . . Versatility

Steel

Substructure contractor: James P. McHugh Construction Co.; *Approaches contractor:* J. M. Corbett Co.; *Electrical contractor:* Wood Electrical Construction, Inc.; *Design and engineering:* Dept. of Public Works—George DeMent, Commissioner; Bureau of Engineering—Dick Van Gorp, Chief Engineer; Div. of Bridges and Viaducts—Stephen J. Michuda, Chief Bridge Engineer; Consultants—A. J. Boynton & Co.

Owner: District of Columbia Armory Board;
Architect and engineer: Dahl-Ewin-Osborn; *Builder:* McCloskey & Co.

NEW STADIUM FOR THE NEW SENATORS,

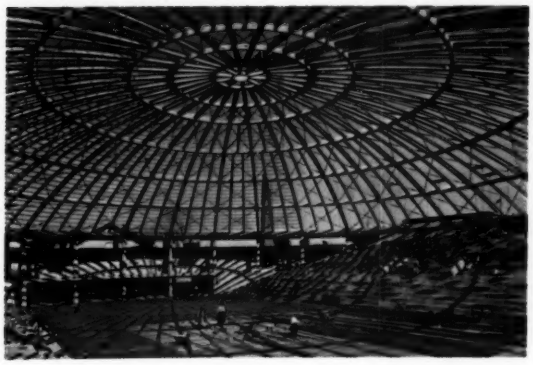
and the Washington Redskins. Sixty-six giant frames cantilever far out over the stands in this unique Washington, D.C., stadium. The frames, welded from Bethlehem steel plate, will support the roof of this $15-million, double-deck, circular structure. More than 7,000 tons of steelwork were fabricated and erected by Bethlehem. Bethlehem also supplied over 5,000 tons of steel reinforcing bars. Seating capacity: 43,500 for baseball and 50,000 for football.

$8½-MILLION VIADUCT

will speed traffic over the Chicago Junction Freight Yard. South Damen Avenue Viaduct will run 4,760 ft, plus 1,940 ft of approaches. The 63-ft width includes two 25-ft roadways, a medial barrier, and a sidewalk. Bethlehem is fabricating and erecting 9,000 tons of structural steel. Pierwork, approaches, and paving will need 2,200 tons of steel reinforcing bars, a major portion of which Bethlehem is supplying.

STEEL DOME FOR UNIVERSITY AUDITORIUM.

Brown University will soon stage its hockey games in this unique structure . . . the George V. Meehan Auditorium. The 208-ft-diam circular dome is framed with 296 tons of Bethlehem structural steel. Some 51,700 linear ft of 1¼-in. Bethlehem steel pipe form a part of the ice-making system. The rink also contains 185 tons of Bethlehem steel reinforcing bars.



Architect: Perry, Shaw, Hepburn and Dean;
Consulting structural engineer: Nichols, Norton & Zaldastani;
General contractor and steel erector: Gilbane Building Co.;
Fabricator: Tower Iron Works, Inc.;
Refrigeration and piping contractor: Henry J. Coupe & Son, Inc.;
Pipe supplier: United Supply Co.

STEEL WATER PIPE FOR ST. PAUL.

Two major lines are among the several phases of St. Paul's farsighted, $21.5 million water supply project. The Fridley Line (above) will be a 42,000-ft, 60-in.-ID main, extending from the Mississippi to a receiving basin. The Vadnais Conduit, 22,000 ft of 90-in. ID gravity-flow line, will deliver water from the storage area to a filter plant. Both lines will consist almost entirely of Bethlehem steel pipe.

Consulting engineer: Black & Veatch;
General contractor: Ashbach Construction Co.;
Subcontractors for Fridley Line: Peter Lametti Construction Co. (Pipe laying),
Moorhead Machinery & Boiler Co. (Welding),
Koppers Co., Inc. (Exterior pipe coating),
Centriline Corp. (Cement mortar pipe lining)

BETHLEHEM STEEL

BIG STEEL BOLTS ANCHOR TITAN MISSILE SHAFT.

Pressure exerted by water seepage in Titan missile-launching silos at Royal City, Wash., tends to "float" tons of steel-reinforced concrete which make up the walls and floors of the silos. Bethlehem is supplying some 2,500 special, 30-ft-long, large-diameter bolts to anchor the floor. Bethlehem is also furnishing more than 2,000 tons of fabricated structural steel for the launchers, and over 4,600 tons of fabricated reinforcing steel for the silos.

Engineer: U.S. Army Corps of Engineers;
Contractor: McDonald-Scott and Associates;
Miscellaneous fabrication: Northern Steel and Supply Co.

THIS 120-TON STEEL TENT frames a restaurant, cocktail lounge, and three function rooms for the Dolphin Motor Hotel, Quincy, Mass. Bethlehem is supplying all the structural steel used in this and the second phase of the 104-unit motel's construction.

Architect: Bedar & Alpers Associates;
General contractor: Oxford Construction Corp.;
Fabricator: Antonelli Iron Works, Inc.;
Erector: Daniel Marr & Son Co.

A COMPLETE LINE OF CONSTRUCTION STEEL

Structural Steel . . . all standard and wide-flange shapes

Open-Web Joists . . . complete series of shortspan and longspan types

Slabform . . . formed sheets for poured concrete floors and roofs

Construction Fasteners . . .
Standard—Bolts, Rivets, Nails, Spikes, Clevises, Turnbuckles, High-Strength Bolts
Specialty—Tie Rods, Anchor Bolts, U-Bolts, Special Fasteners

Fabricated Steel . . . Bethlehem fabricates and erects steelwork for many types of structures

Steel Pipe . . . Butt-Weld, Electric-Resistance Weld, and Electric Fusion-Weld in a full range of diameters

Wire Rope and Strand . . . for all construction uses . . . Stress-relieved Strand for prestressed concrete

Highway Steels . . . beam guard rail, bar mats, dowel joints, bridge rail, and many other highway specialties

Storage Tanks . . . every type of tank for water or fuel storage

Steel Piling . . . wide range of sheet and H-piling, and accessories

Concrete Reinforcing Bars . . . all sizes, with excellent bending and bonding qualities—rolled from new-billet steel

Galvanized Sheets . . . for ductwork, roofing and siding, drainage pipe

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

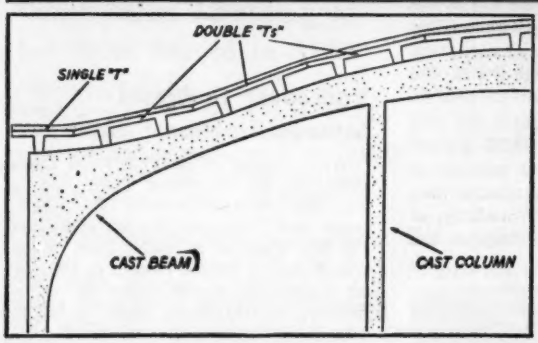
BETHLEHEM STEEL

BETHLEHEM STEEL

MORE PRESTRESSED CONCRETE NEWS:

Photo courtesy James H. Roberts

Flowing and harmonious line of barrel roof forms natural sun canopy at Community Plaza Shopping Center, Boulder, Colorado. Work has been enthusiastically received by professional men and customers alike. Architect: Hobart D. Wagener, Boulder, Colorado. Structural Engineers: Ketchum, Konkel and Hastings, Denver, Colorado. General Contractor: Craftsmen Construction Co., Denver, Colorado. **Prestressed Concrete Fabricator: Rocky Mountain Prestress, Inc., Englewood, Colorado.**



Building consists of 35,000 sq ft of Double Tee, from 35 to 50 ft in length. Drawing shows manner in which concrete arches combine with Double Tee's to form barrel roof.

This Handsome Shopping Center Roof Was Built With Standard Double Tee Sections

"I have shown this picture to other fabricators," reports Jim Synnestvedt of Roebling's Los Angeles Office, "and they *all seem enthusiastic* about the design—the primary reason being that it gave the aesthetic value of a barrel roof with a standard Double Tee product."

No wonder: *only with prestressed concrete* could you hope to achieve such soaring design with such down-to-earth economy. Prestressed standard beams give users other advantages to get enthusiastic about, as well. Speed and convenience of construction, for instance. Fireproofness. Strength. Low insurance rates. Little or no maintenance. It will *pay* you to look first at prestressed whenever you're planning a shopping center, school, office building, plant, warehouse, bridge, motel or any other structure.

Roebling has actively developed and promoted prestressed concrete construction since its beginning in America. For information on tensioning materials, on prestressing in general and for the names of fabricators near you, contact Roebling's Construction Materials Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

News Briefs . . .

ASTM Votes Name Change At its Annual Meeting

The American Society for Testing Materials will henceforth be known as the American Society for Testing and Materials. This change—voted at the organization's recent 64th annual meeting in Atlantic City—is intended to emphasize its interest in materials as well as in testing. In line with its interest in materials per se, the ASTM now has a Division of Material Sciences, which was formed last year to investigate the fundamental characteristics of materials.

At the close of the meeting Miles N. Clair, F. ASCE, president of the Thompson & Lichtner Co., Brookline, Mass., was elected president of ASTM for a one-year term. Mr. Clair has been instrumental in the development of lightweight concrete roof slabs and in the use of concrete made with fine and coarse cinders for structural purposes. He is a past president of the Massachusetts Section of ASCE. In the presidency of ASTM, Mr. Clair succeeds A. Allan Bates, F. ASCE, vice president of research and development for the Portland Cement Association, Chicago.

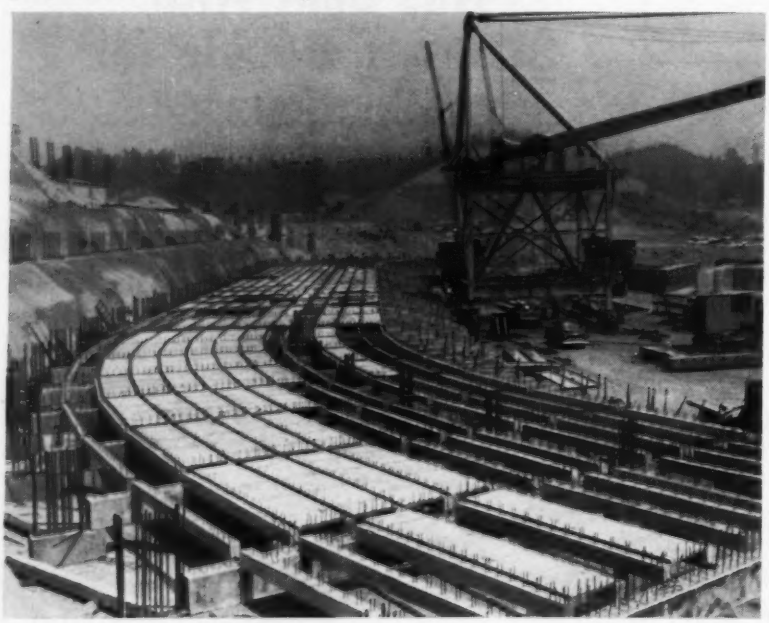
Albert C. Webber, of the research staff of E. I. duPont de Nemours & Co., Wilmington, was elected vice president; and R. Wade Seniff, manager of research for the Baltimore and Ohio Railroad Co., Baltimore, will continue as senior vice president. New directors include Albert G. H. Dietz, M. ASCE, professor of building engineering at Massachusetts Institute of Technology, Cambridge.

Robert R. Litehiser, F. ASCE, engineer of tests for the Ohio State Highway Testing Laboratory, Columbus, was one of several leaders in the field of engineering materials honored with ASTM Awards of Merit. Mr. Litehiser was cited "in recognition of long and notable work in the field of cement, of extensive contributions to many technical committees . . . , and for administrative service."

Two ASCE Fellows were among five named to honorary membership in the ASTM, the organization's top award. They are Theodore Parker Dresser, Jr., president and chief engineer of Abbot H. Hanks, Inc., San Francisco, and a past president of the San Francisco Section of ASCE; and Stanton Walker, director of engineering for both the National Sand and Gravel Association and the National Ready Mixed Concrete Association, Washington, D.C.

Los Angeles Builds New Baseball Stadium

Chavez Ravine, a natural depression near downtown Los Angeles, is the site of the new baseball stadium being built for the Dodgers. This construction view shows first sections of precast lightweight concrete bents and planks, to be placed along the third base line. Planks spanning between bents are thin, reinforced with 6 x 12 -0/3 welded wire fabric. They act as form work for the deck slab, which will be poured, and later will become an integral part of the completed deck. At right is the rail-mounted tower for the 170-ft-boom derrick which will erect most of the 23,000 precast units comprising the major part of the concrete work. Poured-in-place concrete is used for footings, foundations, and wire-reinforced ground slabs. Completion in time for the opening of the 1962 season is scheduled. Praeger-Kavanagh-Waterbury, of New York, is the engineer-architect, and Vinnell Constructors, of Los Angeles, the general contractor. Photo courtesy Wire Reinforcement Institute.



Vancouver Dedicates Sewage Treatment Plant

With opening of its $1,225,000 Lions Gate Sewage Treatment Plant late in July, the Greater Vancouver (B.C.) Sewerage and Drainage District completes the first stage of a master plan, which was drawn up for the District in 1953 by an engineering survey under the chairmanship of AM Rawn, Hon. M. ASCE. The Rawn Report recommended the expenditure of some $65 million to control pollution of waters in the Greater Vancouver area.

The Lions Gate project is a primary treatment plant, designed to serve a West Vancouver population of 32,000 initially and an ultimate population of 64,000. Operation of the fully automatic plant involves the primary treatment of raw sewage, in successive steps, by chlorination, screening and grinding, preaeration, scum removal, sedimentation, digestion, and rechlorination. The treated effluent is discharged into the extremely turbulent waters of Vancouver Narrows, through an outfall pipe 40 ft below the surface. The flow through the Narrows during tidal change is 500,000 cfs. The Lions Gate Plant was designed by the Sewerage District staff, aided by Warren Uhte, A.M. ASCE, of Brown & Caldwell.

A much larger project in the long-range program, the Iona Island Sewage Treatment Plant, is scheduled for opening in early 1963. This second unit will serve Vancouver proper.

Collapsible Form Used for Interstate Highway Bridges

For parallel 1,200-ft-long bridges on Interstate 83 in Baltimore a slightly eccentric 24-ft-long slab section is placed with the cap over the piers (left-hand photo). Balance for the form is maintained by the jacks. The Blaw-Knox-designed form is moved ahead in 18 pieces and reset by manual winches. The Case Construction Co., Mt. Airy, Md., is contractor on the structure, which was designed by Knoerle, Graef, Bender and Associates, Inc., for the City of Baltimore. Concrete between the pier sections is placed on a travelling collapsible form, which is hung from the previously placed slab (view at right). Side sections are shown lowered to pass pier as unit is moved ahead on rails.

Construction Spending to Set New Record in 1961

Spending for new construction is expected to total $57.8 billion in 1961, an amount 4 percent in excess of 1960 expenditures. The record outlay is forecast by the Business and Defense Services Administration of the U.S. Department of Commerce.

Though outlays for private housing are expected to be slightly lower than in 1960, small increases in other types of private construction will probably more than offset the reduced housing expenditures, in the opinion of the BDSA's Construction Industry Division. The overall percentage gain foreseen for private construction is a modest 2 percent. Even so, the expenditures involved will represent a new peak of $40.3 billion. Public construction, showing substantially greater strength than was originally anticipated, is expected to increase 10 percent over 1960.

In the meantime, preliminary estimates of the Department of Commerce's Bureau of the Census place the value of June 1961 construction expenditures at $5.1 billion. This amount was 9 percent above May outlays (the normal seasonal increase between the two months would have been 7 percent) and 2 percent above the June 1960 level.

Cumulative spending for the first six months of this year amounted to $25.4 billion, compared to the $25.1 billion spent in the same period of 1960. Comparative estimates for the same six-month periods, this year and last, show a decline of 3 percent in private construction outlays (from $18.2 billion to $17.8 billion); a decline of 8 percent in private nonfarm residential construction expenditures (from $10.3 billion to $9.6 billion); and an increase of 11 percent in public construction spending (from $6.9 billion in 1960 to $7.7 billion in 1961).

Enlargement of Lake Mathews Completed

Dedication ceremonies celebrating the enlargement of Lake Mathews, terminal reservoir of the Colorado River Aqueduct, took place at the reservoir site, in Southern California, on May 10. The enlargement project, which increased reservoir capacity from 107,000 to 182,000 acre-ft, is part of a $220 million expansion program begun by the Metropolitan Water District of Southern California in 1952. A year ago the main aqueduct was completed to its full planned delivery capacity of a billion gallons a day.

The work of enlarging the reservoir involved raising the existing embankments 33 ft, constructing extensions to existing embankments, and building an additional embankment. It included placing some 6,000,000 cu yd of earth embankment and rock refill and 42,000 cu yd of concrete in embankment paving.

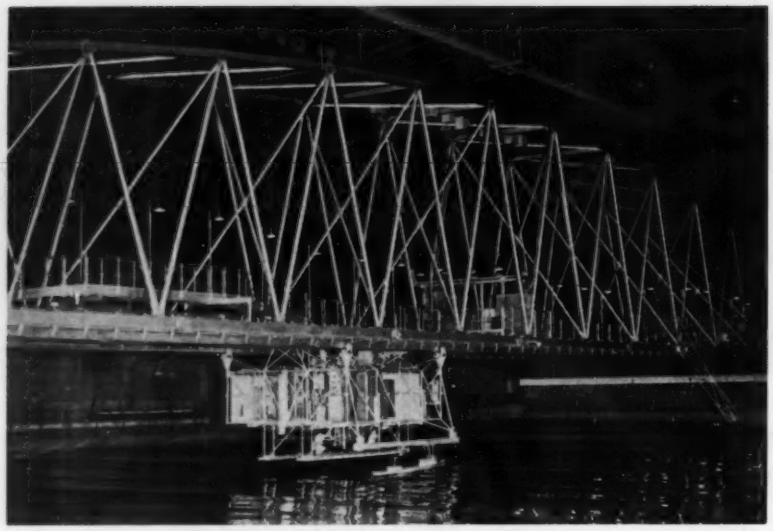
First water flowed into the Cajalco Reservoir, as Lake Mathews was originally called, in November 1939. A year later the reservoir was officially named Lake Mathews in honor of W. R. Mathews, general counsel for the District, in recognition of his "notable services" over the years in advancing the Colorado River Aqueduct and in establishing the Metropolitan Water District. Mr. Mathews died in 1931.

The enlargement project was discussed by Robert B. Diemer, F. ASCE, general manager and chief engineer of the Metropolitan Water District, in a recent issue of the *Colorado River Aqueduct News*, from which this item was taken.

Alaska May Have Harbor Made by Nuclear Blast

Creation of an artificial harbor in Alaska by means of nuclear explosives is being considered by an Atomic Energy Commission scientific panel. Planned as part of the postponed "Project Plowshare," the harbor job (Project Chariot) would be at Ogotoruk Creek, about 250 miles north of Nome. Four atomic bombs of Hiroshima size, and one ten times larger would be buried at depths of 400 and 800 ft, and detonated to create a channel, 900 ft wide and half a mile long, plus a turning basin 1,800 ft in diameter.

The eight-man AEC panel is of the opinion that 95 percent of the fission products would be trapped underground and that the remaining 5 percent would do little damage to the 450 people living within a 40-mile radius of the site. However, continuous studies of effects would be necessary, after the explosion. At present the project awaits international action on nuclear testing.



Here a 16-ft model of a high-speed replenishment ship traverses irregular long crested waves in the Maneuvering and Seakeeping facility at the David Taylor Model Basin. For size comparison, note men on platform just above the water.

Man-Made Ocean Dedicated at Taylor Model Basin

On June 20, the Navy put into operation the largest simulated "ocean" in the world at its David Taylor Model Basin, Carderock, Md. The huge building covers five acres and houses a rotating arm basin 260 ft in diameter, a seakeeping and maneuvering basin, and a variable-pressure water tunnel.

With these new facilities, the Navy will be able to predict full-scale performance of waterborne vehicles in realistic seas and to solve complex problems of their stability and control. Though the Navy has been predicting ship performance for more than sixty years by means of model tests, its tests have heretofore been confined to smooth water with "regular" wave effects. Now tests can be run in waters more nearly resembling actual ocean conditions. The larger tanks will also permit many maneuvers in testing the handling qualities of ships that could not be executed in the smaller tanks. The rotating arm basin will permit testing submerged submarine models.

The project is under the Navy Bureau of Ships, which marks its twenty-first anniversary this year. Capt. Jack A. Obermeyer, U.S.N., is commanding officer and director of the Basin.

Wheeler Lock to Be Entirely Rebuilt

A construction schedule has now been established under which the damaged lock at Wheeler Dam in northern Alabama (July issue, page 85) will be replaced. Normal commercial river traffic will be restored on the Tennessee River about June 1, 1962, according to L. J. Van Mol, general manager of the Tennessee Valley Authority.

Replacement of the lock will be a much more extensive construction job than was anticipated prior to engineering inspection of the damaged structure. Examination of the standing (river) wall of the old lock disclosed cracks, and the danger of future cracking, which make it unsafe merely to repair it. The rebuilding will include not only replacement of the damaged (landward) wall but also the standing wall.

The lock will be rebuilt 60 ft wide and 400 ft long—40 ft longer than the old lock chamber. Design is now in process. The Nashville Bridge Company was given an order in June for fabrication of new downstream gates for the reconstructed lock.

A request has been made to Congress for an emergency appropriation of $7 million for work during the 1962 fiscal year, including funds for assisting shippers in transferring cargoes around and over the dam.

Work will proceed jointly and simultaneously on the large 110-by 600-ft new lock on which construction had begun at the time of the accident. Completion of the new lock is scheduled for April 1963, just three months later than originally planned.

SEATO Forms Graduate School of Engineering

A Graduate School of Engineering for advanced students in the South East Asian countries has been in operation for the past two years in Bangkok, Thailand, under the auspices of the Southeastern Asia Treaty Organization. So far the school offers only work in civil engineering, as this branch of the profession was felt to be of primary importance to the undeveloped Asian nations. Two-year courses, leading to the Master of Engineering degree, are currently available in hydraulic, highway, structural, and sanitary engineering. The equivalent of a bachelor's degree is required for admission.

Colorado State University, together with the International Cooperation Administration, was the contractor for the United States' share of support to the project, which also received support from the seven other SEATO nations. T. H. Evans, F.ASCE, dean of engineering at Colorado State University, was instrumental in getting the school organized and in operation and acted as first dean. The project was unique in that the university was not acting as adviser to a foreign university, but actually had the responsibility of organizing and operating the school as an independent unit.

Arnold Center to Have High-Altitude Test Cell

Award of a $9,950,000 contract for building the free world's largest high-altitude test cell at the U.S. Air Force's Arnold Engineering Development Center, near Tullahoma, Tenn., has been announced by the Mobile District of the Corps of Engineers. The contract goes to the Blount Brothers Corporation, of Montgomery, Ala., who submitted the lowest of seventeen competitive bids. The cell was designed by the Sverdrup and Parcel Engineering Company, of St. Louis, under a contract awarded by the U.S. Air Force at Arnold Center.

The facility, called a Rocket Engine Altitude Test Cell, will be used for testing full-scale rocket engines under ultra-high conditions. It consists of a circular hole excavated to a diameter of approximately 106 ft and a depth of 250 ft, lined with reinforced concrete of varying thickness. It will contain a device for holding the rocket engine, a diffuser, a deflector, an exhaust duct, a personnel elevator, and a cooling system, and will be served by a 100-ton overhead crane on an outside runway.

In the test cell, a complete stage of a missile with the engines operating, can be tested in its natural vertical flight position at simulated altitudes of over 100,000 ft. Use of the cell will enable Air Force scientists to make detailed engine studies of the various phenomena occurring during a missile flight through the stratosphere without expending the missile.

Contract Awarded for Arizona Missile Site

The U. S. Army Corps of Engineers has awarded the Fluor Corporation, Ltd., of Los Angeles, a $35.6-million contract to carry out the Phase II construction of 18 Titan II missile sites in Arizona. When completed in 1964, the ICBM battery will comprise the first two operational squadrons of Titan IIs. The "hard launch" defense facilities are keyed to Davis-Monthan Air Force Base in an area of several hundred miles circling Tucson. Each site consists of a silo, tunnel, and control center deep under ground. Each silo will house a Titan II.

Phase II will consist of the installation at each complex of government-furnished ground-support components, equipment, and systems in addition to contractor-purchased structural steel, piping, and a portion of air conditioning and mechanical equipment. Phase II is tentatively scheduled for completion in the fall of 1962.

The Martin Company designed the Titan II project.

Contract Awarded for New Snake River Dam

A $2,664,000 contract for construction of the first stage of Lower Monumental Lock and Dam on the Snake River in eastern Washington has been awarded to the Henry J. Kaiser Company, as sponsor, and the Puget Sound Bridge & Dry Dock Company, as participant. The contracting agency is the Walla Walla District of the Corps of Engineers.

The first stage will involve construction of a cofferdam on the south shore, installation of pumping equipment for dewatering the cofferdam, excavation of a diversion channel on the north shore, and construction of part of the permanent earth embankment. Completion of the first stage is planned for early 1962.

Located 27 miles above Ice Harbor Lock and Dam, the new project will consist of a concrete spillway dam across the Snake River, with a lock on the south shore and a powerhouse with initial capacity of 363,000 kw on the north shore. The dam will be tied into each bank with earth embankments.

Army Awards Contracts For Michigan Projects

The Detroit District of the Corps of Engineers recently awarded eight contracts totaling nearly $2.5 million for military and civil construction projects in Michigan.

The largest single contract in this group was awarded to the Southern Engineering and Construction Company of Long Beach, Calif. This contract, amounting to $1,353,753, went for the erection of maintenance docks and support facilities at three Michigan Air Force Bases—Kincheloe, K. I. Sawyer, and Wurtsmith. An unusual feature of the work is that all-steel maintenance docks, surplus at Biggs Air Force Base, Texas, will be dismantled and shipped to Michigan for re-erection—one at each of the Air Bases. The docks are approximately 14,400 sq ft in area and 49 feet high.

Steel Picture for First Six Months of Year

Steel output in the United States in the first six months of this year totaled 44,857,804 net tons, according to a preliminary report of the American Iron and Steel Institute. Contributing to this output was the June production of 8,551,000 tons—up 15.5 percent from the June 1960 output (7,404,873 tons) and down only slightly from the total for the longer month of May 1961. Production in the second quarter of this year increased 27.2 percent from the 19,741,491 tons poured during the first quarter of 1961.

The first-half total represented a gain of 16.4 percent when compared with the output in the last half of 1960. However, the total for the comparable (first-half) period of 1960 was 60,754,095 tons.

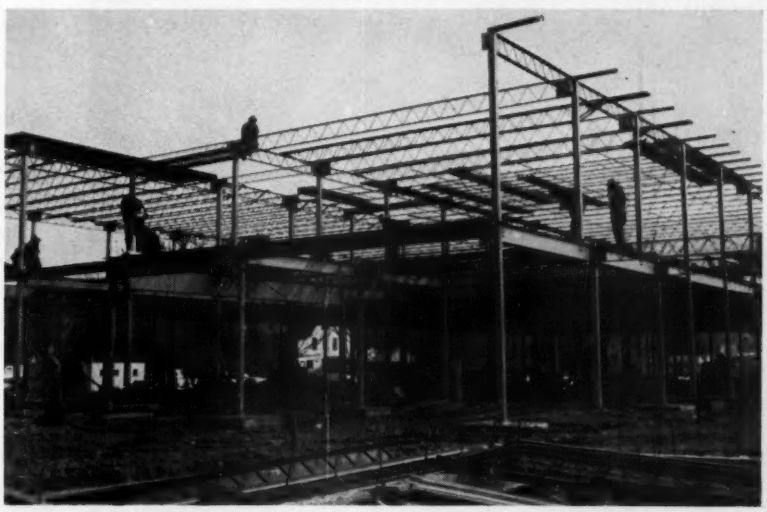
W. T. Chevalier, Former Director of ASCE, Dies

Willard T. Chevalier, a distinguished engineer and publisher and former Director of ASCE, died on June 29 at the age of 75. Mr. Chevalier joined the staff of *Engineering News-Record* as an associate editor, and later rose in the organization to become executive vice president and director of the McGraw-Hill Publishing Company. He retired from the directorship only this year. He was a civil engineering graduate of Brooklyn Polytechnic Institute and a veteran of World War I. He was cited for "exceptionally meritorious and conspicuous services" with the 11th Engineers in France.

A member of ASCE in various grades since 1909, Mr. Chevalier served as Director from 1925 to 1927. He was also secretary and president of the Metropolitan Section in the days when it was known as the New York Section. He had been president of the American Road Builders Association; director of the Society of American Military Engineers; and director of the American Water Works Association. He was also an honorary member of the AWWA and holder of its John M. Goodell Prize.

New School Features Hot Rolled Structural Tubing

First use of rolled structural tubing, a new National Tube product, is featured in this 55-classroom school now under construction at Elmira, N.Y. The vertical columns shown are part of a 162-ton order of 5-in. square tubing. They are being incorporated into a lightweight framework as part of the modular construction system employed by the American Bridge Division of U.S. Steel. Use of the modular system will make the total cost of the school $174,000 less than the planned cost, despite an increase of 7,962 sq ft in area provided in final plans. The new tubing is expected to have important design and fabrication advantages.



Three-quarters of the "Old Town" Bridge is shown in use at its new site over Calleguas Creek, Ventura County.

How to make two new bridges from

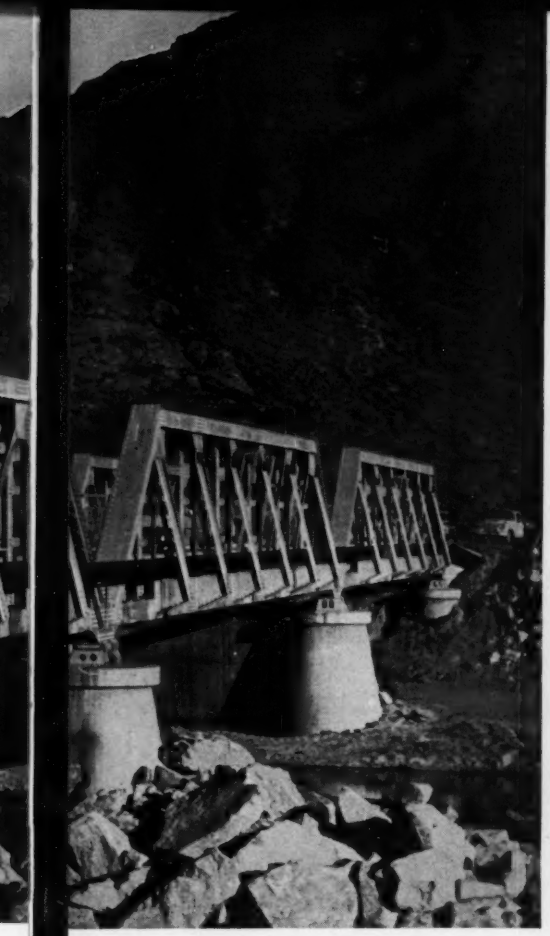
But don't try it unless you've got a steel bridge to start with.

When boom years came to San Diego and its suburbs, traffic zoomed. The "Old Town" Bridge you see at lower left was forced into retirement by the new four-lane, freeway-type steel bridge directly behind it.

So they sold the 35-year-old bridge

Even though it was 35 years old, the "Old Town" Bridge *still* met the specifications of the county and state bridge engineering codes for width, strength, and load-bearing capacity! So the city of San Diego sold it to Macco Construction

◀ *After serving San Diego well for 35 years, the "Old Town" Bridge was dismantled . . . but not discarded. Within two months it became the two bridges you see above. (Bethlehem Steel fabricated and erected all the steel for all the bridges you see in these photos.)*



One-quarter of the "Old Town" Bridge now crosses a creek bed in Foster Park, Ventura County, California.

one old one . . . and save $30,000!

Company, who dismantled the bridge and, in turn, sold it to the Bailey Bridge Equipment Company of San Luis Obispo. This company then sold the bridge to Ventura County highway authorities to build *two* urgently needed bridges.

They trucked bridge trusses 200 miles

The 8 dismantled bridge trusses were trucked 200 miles northward. One truck was needed for each of the 18-ton, 104-foot-long trusses; two other trucks hauled the steel floor sections of the bridge.

The whole job took just 2 months

In Ventura County, three spans of the old four-span bridge were erected to span Calleguas Creek. The fourth span was erected to span Coyote Creek. One bridge was now two bridges! And the whole operation—from beginning of dismantling to finish of re-erection—had taken only two months!

SAVED $30,000

According to highway officials of Ventura County, the bridges are as good as new ones . . . and they cost $30,000 less than the estimated cost of building new bridges.

What other bridge material is as adaptable as steel?

You can *widen* a steel bridge—easily. You can *re-use* structural steel. And you can *scrap* structural steel and get something back on your original investment. Steel is the *adaptable* bridge material. Our nearest sales office will gladly tell you more.

Look to the future
...design with steel

Steel

for Strength
... Economy
... Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

BETHLEHEM STEEL

New Chairman for Ohio River Sanitation Commission

Dr. Charles L. Wilbar, Jr., of Harrisburg, Pa., a state health administrator closely associated with the crusade for clean streams, took office on July 1 as chairman of the Ohio River Valley Water Sanitation Commission. Dr. Wilbar has been a commissioner of the agency since 1957, when he was appointed Secretary of Health for the Commonwealth of Pennsylvania. He is also chairman of the Pennsylvania Sanitary Water Board.

The Sanitation Commission is the coordinating agency for eight states in the Ohio Valley, who joined in a regional compact some years ago for the abatement of water pollution. The signatory states are Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia.

Edward Cleary, F. ASCE, is executive director of the Commission.

Troy, N.Y., to Have New Water Works

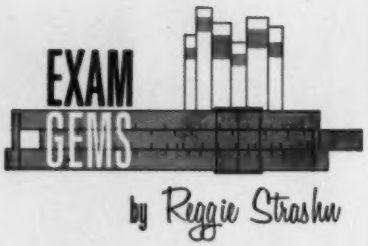
The City of Troy, N.Y., has engaged the Boston consulting firm of Camp, Dresser & McKee to prepare final plans and specifications for the construction of major improvements to its water works. The project, to be built for the Troy Water Bureau, will include a 30-mgd filtration plant, a pumping station, storage tanks (of 4 and 5-million-gallon capacity), and connecting mains. Total cost of the work is estimated at $7.5 million.

IBM Dedicates New Research Center

The International Business Machines Corporation has dedicated its recently completed Thomas J. Watson Research Center at Yorktown, in suburban Westchester County, 40 miles north of New York City. The new facility—said to be the world's largest research center for the study of computer sciences—is a dramatic three-level, crescent-shaped structure with a curving glass front. Large areas of floor-to-ceiling glass and exterior and interior walls of native field stone are dominant architectural features of the building.

The new center will provide 459,000 sq ft of working space for a staff of some 1,500 scientists and supporting personnel. It will be devoted to research programs in the physical sciences, mathematics, the life sciences, and advanced engineering. Many ideas formulated at the center will flow into IBM development laboratories for possible use in data and information processing systems.

Ground for the center was broken in October 1958, with the W. L. Crow Construction Company, of New York, as general contractor. Eero Saarinen was the architect.



It was explained last month why EXAMGEM 25 was a reassignment of No. 24, for which the usual solution neglected energy levels. Pertinent factors upstream and downstream from the side spillway in the canal could be derived from the given data as follows:

Factor	Symbol	Up-stream	Down-stream	Change
Discharge	Q	650	468.2	181.8
Depth	y	6.474	5.50	0.974
Velocity	v	5.093	4.665	0.428
Velocity head	h_v	0.404	0.338	0.066
Specific energy	E	6.878	5.838	1.040
Mean depth	d_m	4.337	3.788	0.549

Since $2h_v < d_m$, flow will be streaming, with control downstream. Unless drop in depth is sudden, the drop in energy in addition to invert gradient will steepen the energy gradient and accelerate the flow. No doubt much of this acceleration will occur in a drawdown approaching the spillway, reducing the head on the spillway an unknown amount. This must be followed by deceleration along the spillway to meet the downstream control. If these transitions are long and gradual, we can compute by pseudo-conservation of energy according to the Bernoulli Law ($E_u - h_f = E_d$). Fig. 1 shows theoretical profiles of energy grade (E) and hydraulic grade (H) with respect to spillway grade ($y = 5$) which

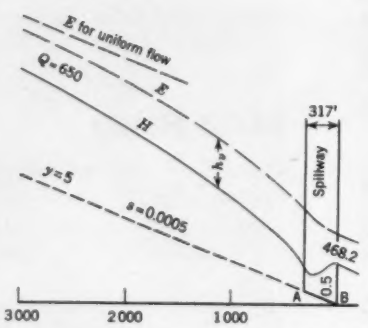
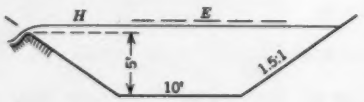


Fig. 1. Canal drawdown reduces head on spillway crest AB to 0.20 ft at A.

Fig. 2. Canal section at side spillway, showing negligible effect of transverse drawdown on canal elements.



the engineer should visualize qualitatively before computing.

Transversely (Fig. 2), drawdown toward the spillway crest, slightly reduces area and wetted perimeter, but negligibly. If the longitudinal stream were deflected by efficient baffles, head on the spillway crest would be measured by the E grade; lacking baffles, the head is limited to the H grade ($y - 5$). Flow over the weir is diagonal, composing the longitudinal velocity due to head $E - H$ with transverse velocity due to $H - 5$.

The following tabulation modifies the average-end-area method to fit the case of an unknown length of section. We know only a downstream-end situation and the discharge at the upstream end of the reach. The procedure tries a depth y_u at the upstream end, computes the unit spill q at each end from $q = 3.34(y - 5)^{1.47}$, uses the average q as the mean to compute length of reach from $L = \Delta Q / q_m$, uses the average slope as the mean to find the increment of specific energy from $\Delta E = L(s_m - 0.0005)$ and energy at upstream end from $E_u = E_d + \Delta E$, and finally subtracts the velocity head at the upstream end from E_u to obtain another y_u. This will usually differ from the trial and converge on the answer, so it is used for a second trial. From the trend of convergence, a third trial can be estimated accurately and proved.

Factor	Trial 1	Trial 2	Trial 3
y_u	5.50	5.221	5.144
q_u	1.206	0.362	0.192
q_m	1.206	0.784	0.699
L	151	232	260
$10^4 s_u$	9.64	11.84	12.58
$10^4 s_m$	7.32	8.42	8.79
$10^4 s_u$	2.32	3.42	3.79
ΔE	.035	.079	.099
E_u	5.873	5.917	5.937
h_v	0.652	0.759	0.793
y_u	5.221	5.158	5.144

Obviously q and s are far from linear, introducing a large error. This can be reduced by taking two equal steps, first to $Q = 559.1$ and second to 650 to find $L = 299$. Three steps gives 312 and eight 317.3. But even the first is far better than the 64.1 computed by the erroneous interpretation. Using hydraulic tables, Manning Charts and loglog rule, the method is fast and has the facility of computing a better trial at each step, with rapid convergence.

EXAMGEM 26

Every examination should feature problems that require less arithmetic and more plain old-fashioned thinking, like this gem used in California in 1937.

A 10-in. seamless steel pipe with welded joints to carry oil at a working pressure of 400 psig will cross San Andreas Fault in San Joaquin Valley. The fault zone is nearly a mile wide on a gently sloping outwash plain, within which displacements of several feet horizontally and vertically should be anticipated. In order to minimize hazard of damage to pipeline, outage of service and loss of transmittant, what measures would you recommend for design, construction and maintenance of the line?

LAYING PIPE UNDER WATER was the tough assignment of Lloyd Kispert & Son, contractors of Green Bay, Wisconsin, at the town of Preble, Wisconsin.

Below the water table... water-tight joints

Lloyd Kispert & Son recently laid 3611 feet of 12-inch K&M Asbestos-Cement Sewer Pipe within a few hundred feet of Green Bay. The water table was so high that the pipe was laid under water. Nevertheless, all joints had to be infiltration-tight. On the next page, Mr. Kispert, in his own words, tells how he solved this problem.

You can dig flatter grades for K&M Asbestos-Cement Sewer Pipe because its bore remains smooth and clean.

Water, snow, mud, and rain can't hold up the installation of K&M Asbestos-Cement Sewer Pipe.

"K&M ASBESTOS-CEMENT GRAVITY SEWER PIPE GAVE US PERMANENTLY TIGHT JOINTS IN WET GOING!"

"This was an extremely rough job. But, with K&M Pipe, we got tight joints in wet going. The K&M FLUID-TITE® Coupling connected easily, even under water. The men just had to lubricate the tapered end of the pipe and slide it into the coupling. We didn't need any heavyweight coupling pullers. Our men had an easy time handling the pipe because of its light weight. We are very satisfied with K&M Pipe and will use it again."

Mr. Lloyd Kispert

You could lay K&M Asbestos-Cement Sewer Pipe at the bottom of a 58′ deep lake, and it would be infiltration-tight.

The smooth bore of this modern pipe remains clean, permanently. The friction coefficient is low. You can plan fewer lift stations and flatter grades.

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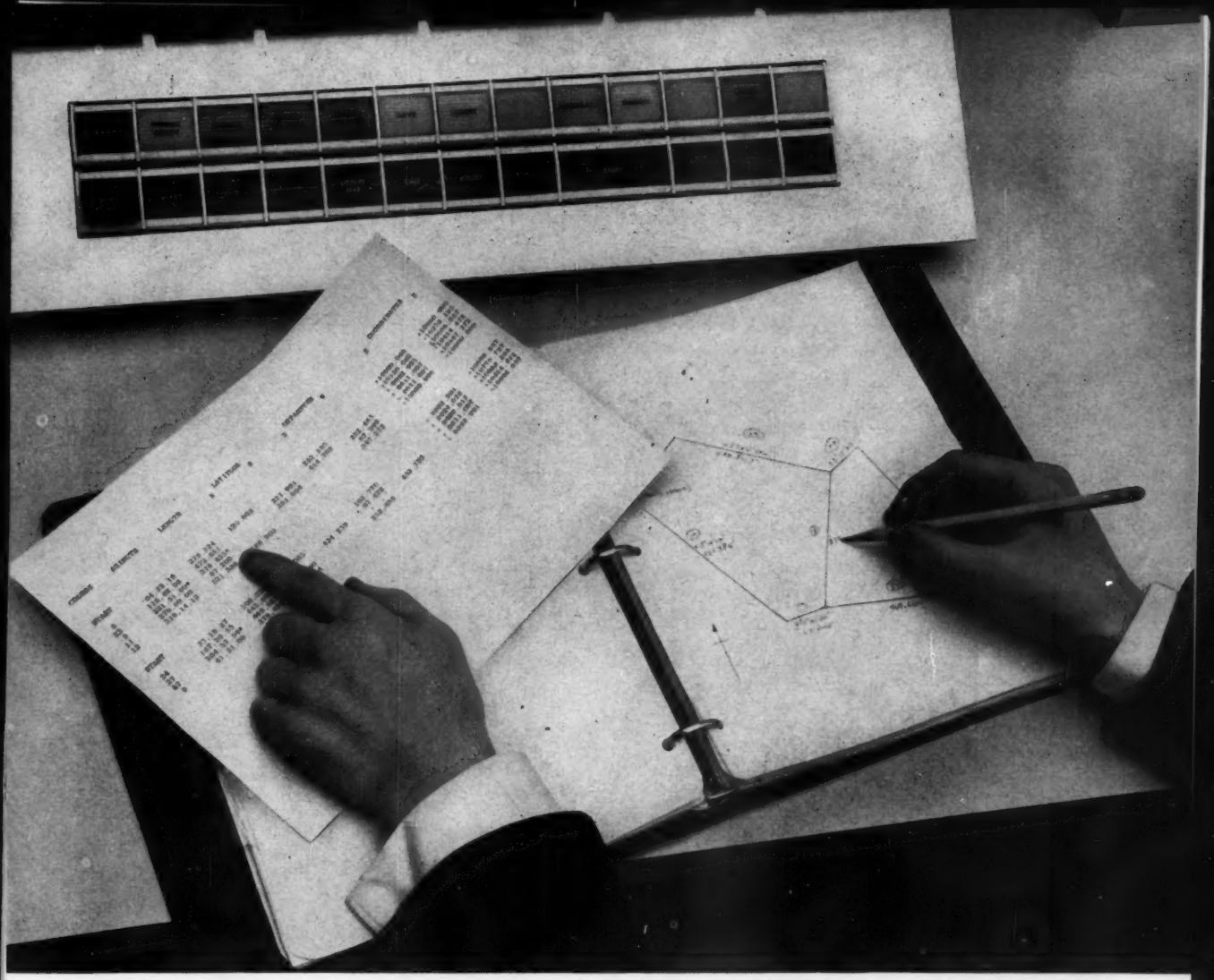
Keasbey & Mattison at Ambler

For more information on this top-quality gravity sewer pipe, write to: Keasbey & Mattison Company, Ambler, Pa.



A time-saving package for the subdivision engineer... the IBM 1620 traverse closure and curve data program

It calculates a seven-sided traverse in less than *one minute* from the time you put the paper tape in until the typewriter prints out the solution. Users of the 1620 Data Processing System can have this new program free-of-charge.

The program actually consists of two programs—*traverse closure program* and a *lot and general curve data program* incorporating the same subroutines. The traverse program will accommodate thirty-sided traverses. It will automatically select the proper method of computing the missing bearing(s) and distance(s) from among the five possible end solutions. For each course it prints out the course number, bearing, distance, end coordinates, and the traverse area in square feet and acres.

The program is flexible—you may use typewriter or paper tape input—you can decide whether the program is to report bearing and angles in tenths of seconds or seconds.

And, you'll find that the 1620 is easy to use, fast and powerful. It's the most outstanding engineering and scientific computer in its price range. A basic installation rents for just $1600 a month.

To learn how the 1620 can free you for more creative engineering work, call your local IBM Representative.

IBM's 1620 is a compact desk-size computer.

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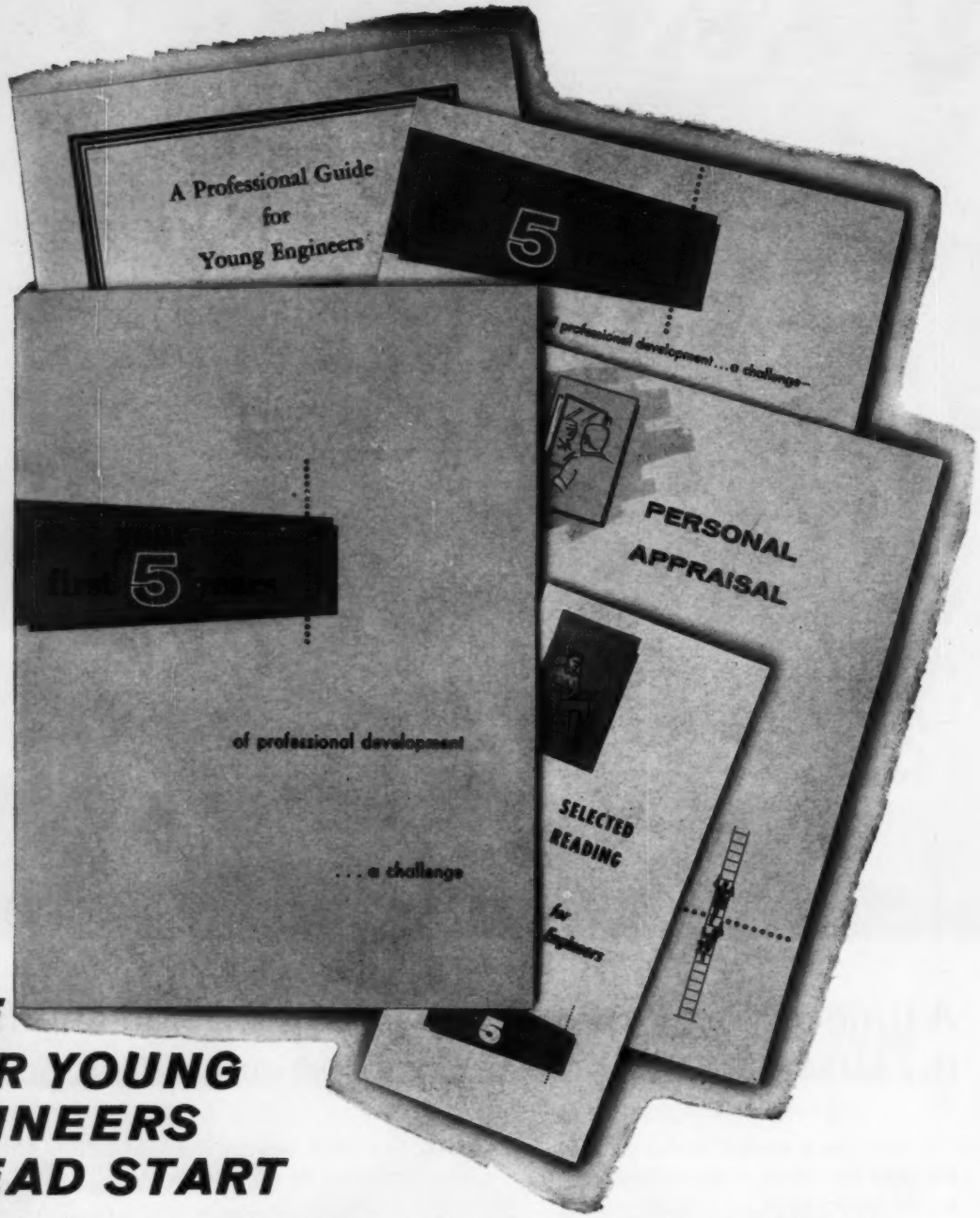

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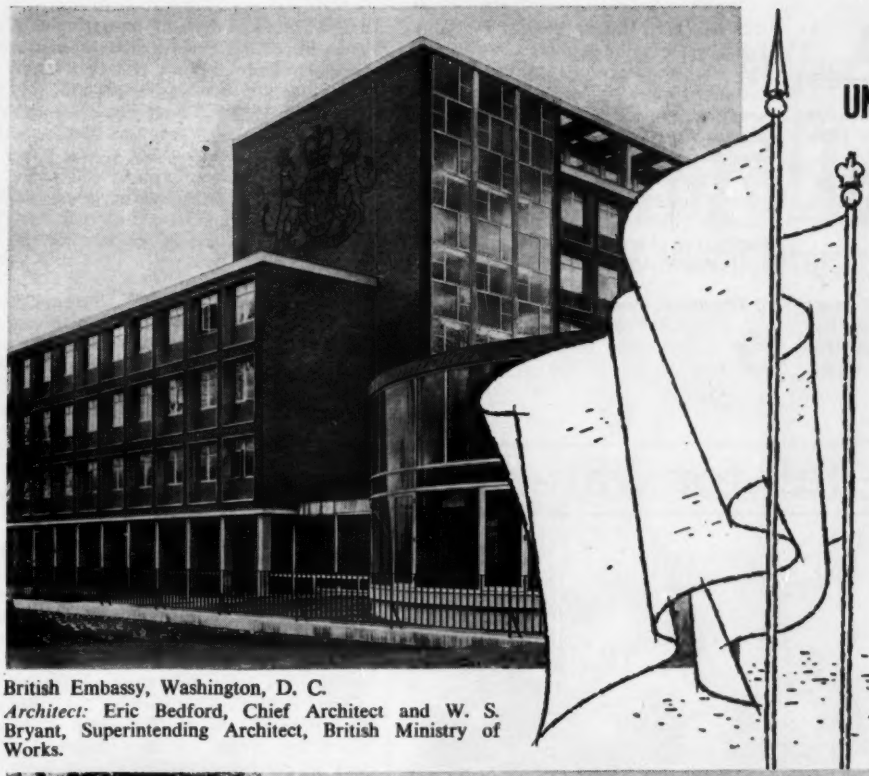

British Embassy, Washington, D. C.
Architect: Eric Bedford, Chief Architect and W. S. Bryant, Superintending Architect, British Ministry of Works.

Swiss Embassy, Washington, D. C.
Architect: William Lescaze, New York, N. Y.

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DECEASED

Jose Manuel Bisbe (J.M. '57; A.M. '59), age 26, of Havana, Cuba, in 1956 received a bachelor degree in civil engineering from Rensselaer Polytechnic Institute and the following year, became a teaching assistant in the civil engineering department there.

Harry Edward Blakeley (M. '56; F. '59), age 56, for the past several years was highway engineer with the U.S. Bureau of Public Roads in Atlanta, Ga. This had been preceded by several years each with the C. N. Harrub Engineering Company, where as an Associate member of the firm he supervised construction of municipal water systems, filtration plants, sewerage systems and sewage treatment plants; with Wiedeman & Singleton as resident engineer in charge of constructing a water filtration and sewage treatment plant at Aiken, S.C.; and with the Georgia Highway Department as project engineer in charge of constructing part of the Greater Atlanta Expressway System.

Chester E. Booth (M. '46; F. '59), age 76, from 1945 to 1955 was a civil engineer with Ebasco Services, Inc., in responsible charge of the structural and architectural design of power plants. Then about five years ago he opened a limited practice in Forest Hills, N.Y., as a consulting and structural engineer. From 1917 to 1945, Mr. Booth served with the Naval Bureau of Yards and Docks on two separate occasions (World War I and II); with the Electric Bond and Share Company as a structural engineer; and with the American Gas and Electric Service Corporation as an engineering designer.

George Burch (M. '18; F. '59), age 75, who as long ago as 1909 had been employed by the Illinois State Department of Highways as a superintendent on construction in the bridge division, remained with the Department until about 1950. Between 1912 and 1950 he was promoted to assistant bridge engineer in direct charge of the Bureau of Bridges, and, then to bridge engineer.

Edward North Chisolm (M. '19; F. '59), age 83, having joined the Corps of Engineers in 1919 with the rank of Captain, retired some 20 years later as a Lieutenant Colonel. His previous engineering experience was as assistant engineer with the Bethlehem Steel Company at Sparrows Point, Md.; as consulting engineer, with offices in Charlotte, N.C., and Columbia, S.C.; as chief engineer of the Knoxville, Tenn., Water Department; and, as early as 1903, as city engineer and superintendent of Water Works for Columbia, S.C.

Howard G. Curtis (M. '50; F. '59), age 66, an authority on the design of canals and pipelines for water resources development projects, was head of the Canals and Pipelines Section at the U.S. Bureau of Reclamation Engineering Center in Denver, Colo., at the time of his recent death. Appointed in 1926 assistant engineer in the Bureau's Denver office, he subsequently supervised designs of canals and irrigation distribution systems for such major Reclamation developments as the Boulder Canyon, Central Valley, Gila, and Missouri River Basin Projects.

Samuel C. Dunlop (A.M. '10; M. '59), age 83, retired engineer of Miami, Fla., during a long career served for several years as resident engineer with the Virginia Railway; as assistant city engineer of Norfolk, Va.; and as assistant engineer in charge of construction of the Charleston (S.C.) Sanitary Sewer System.

Harry I. Dygert (A.M. '10; M. '59), age 84, prior to his retirement in the early 1940's, was for many years city engineer of Albany, Calif. To the job of city engineer Mr. Dygert brought years of experience gained as a private consultant in San Francisco and as assistant engineer with the Berkeley (Calif.) firm of Stephen E. Kieffer.

Floyd W. Frederick (M. '14; F. '59), age 84, retired about ten years ago to Easton, Pa., after a long and active career, which included a private consulting practice in Pennsylvania; the post of professor of mechanical engineering at Howard University in Washington, D.C.; and

MH Roll-call for water

Indians Say: "Ugh! Too Many White Man!"

In 1814, when Jackson defeated the Creek warriors at Horseshoe Bend, Ala., it probably never had occurred to anyone that someday there would be so many people in the east-south-central States that there could be a shortage of water!

But that Indian defeat was the beginning of a new era. It set the stage for settlement of the Deep South by white people. Immigrants poured into the section, started growing cotton, then corn, then livestock. Later they discovered coal, iron ore and other minerals until sections of this country today support a great industrial economy.

It would have been hard for Andrew Jackson to believe that there ever would be 29 public water systems in this Deep South country, each supplying 25,000 or more population; but that 5 (16%) of the 29 water systems would be of doubtful efficiency and 4 (13.7%) of them would be definitely deficient. Yet, this section of the U.S. is in better shape than the country as a whole where the definite water system deficiency runs 26.6% and the doubtful efficiency totals 23.2%.

Kentucky
Tennessee
Alabama
Mississippi

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employment as a mechanical engineer with Underwriters' Laboratories, Inc., in Chicago, Ill. Very early in his career Mr. Frederick did original design of high speed engines for the Russell Engine Company of Ohio.

Benjamin E. Jones (M. '36; F. '59), age 78, for 44 years an engineer and water power authority with the U.S. Geological Survey, began his career with the Survey in 1913. Upon his retirement in 1953 as chief of the Water and Power Branch of the Survey, Mr. Jones received the Distinguished Service Award of the Interior Department. Mr. Jones assisted in preparing for the Versailles Peace Conference estimates of world water power. He also made the first geophysical investigations undertaken by the Geological Survey for dam-site selection, and supervised the surveys for Grand Coulee and other large dams.

Aksel H. Jorgensen (M. '26; F. '59), age 78, during his long career specialized in tunnel and foundations work in the New York City area. As assistant engineer with the New York—New Jersey Bridge and Tunnel Commission, Mr. Jorgensen was in charge of constructing the New York approaches and ventilation system, and foundations for the Holland Tunnel. More recently he was assistant project engineer on the Queens Midtown Tunnel, and just prior to his retirement was supervising engineer with Seelye, Stevenson, Value & Knecht of New York.

Edward D. Kingman (A.M. '13; M. '59), age 77, retired head of the Department of Applied Mechanics at Wentworth Institute in Boston, Mass., had also been on special writing assignments with the McGraw-Hill Publishing Company from 1920 to the 1950's. Professor Kingman began his teaching career as an instructor in civil engineering at Michigan State College in 1911. From there he went to the University of Wisconsin where he was an assistant professor and, just prior to joining the faculty of Wentworth Institute in 1918, served in a similar capacity at the University of Maine.

Harold Ware Lippincott (A.M. '45; M. '59), age 59, after serving with several Kansas and Oklahoma engineering firms, joined the Stone and Webster Corporation as construction superintendent in the 1930's, in which capacity he had since served the firm's interests throughout the United States and Canada. In 1959, his increased responsibility brought him to the firm's central offices in Boston, Mass.

Bernard F. Locraft (M. '42; F. '59), age 59, prominent Washington, D.C., engineer, performed surveying, structural design and foundations and drainage work on several Federal buildings, among them the extension of the Capitol, the new Senate Office Building, the Pentagon and structures in the Federal triangle, as well as work at Catholic and Georgetown Universities. Recipient of the 1960 Award of the Washington Society of Engineers as the District's "Out-

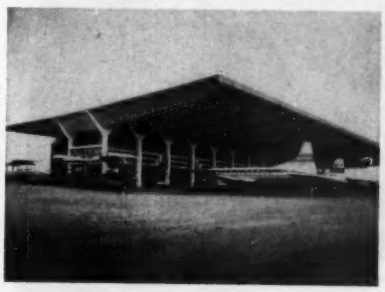
(Continued on page 100)

8th major project by Vibroflotation®
at Miami International Airport

Vibroflot machines compacting sand foundation to a depth of 20' for new 2-level, 5-acre parking deck between the airport's entrance ramps. Architects: Steward-Skinner Associates; Consulting Engineer: William H. Weaver; General Contractor: Fred Howland, Inc., – all of Miami, Florida.

Other projects at Miami International Airport

National Airlines	(1) Administration Building
	(2) Cantilever Hangar
Delta Airlines	(3) Loading Pier
	(4) Maintenance Hangar
	(5) Fuel Tanks
American Airmotive Corp...	(6) Cantilever Hangar
Miami Skyways Motel	(7) Deluxe Motel



Cantilever hangar pictured at left was project No. 2 for National Airlines. Architect: Weed, Russell, Johnson and Associates, Miami; Consulting Engineer: Ammann & Whitney, New York; Soil Consultant: D. M. Burmister, New York; Contractor: Fred Howland, Inc., Miami.

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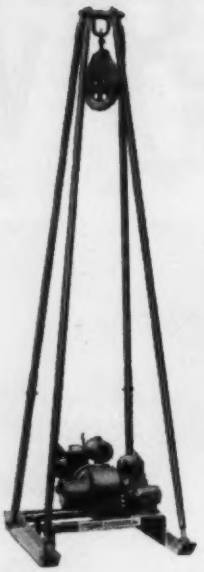

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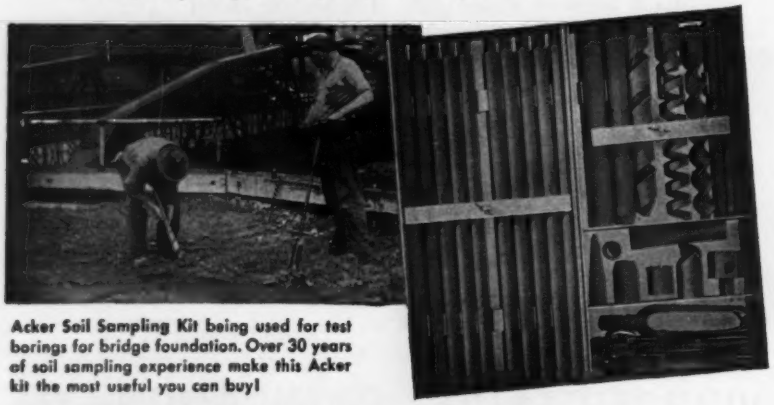

Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

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standing Engineer," at the time of death Mr. Locraft's projects included the new House Office Building, the District of Columbia Stadium, the library addition to Dumbarton Oaks and phases of the city's Southwest redevelopment.

Charles Gurdon Marchant (A.M. '51; F. '59), age 45, from 1948 until his recent death was a partner in Marchant and Minges, of West Hartford, Conn. During these years the firm worked on various engineering projects in the Massachusetts-Connecticut area, such as the Bradley Field hangar and supporting facilities for the Corps of Engineers, the Litchfield County Hospital, the Nuclear Research Laboratory at the New London (Conn.) submarine base, six Nike housing projects in Boston, and the University of Hartford in Connecticut.

Burnett P. McWhorter (M. '52; F. '59), age 80, since his retirement from the U.S. Bureau of Public Roads five years ago, had served in a consulting capacity in the states of Florida and Georgia. At the time of his retirement, Mr. McWhorter was regional engineer with the Bureau in the Atlanta, Ga., office.

Franklyn Dana Nash (M. '14; F. '59), age 87, consulting engineer of Arlington, Va., went into semi-retirement in the early 1950's after a 15-year association with the Federal Power Commission in Washington, D.C., as senior engineer. His background also included service as division engineer in charge of roads, bridges, and buildings in the Philippine Islands for the U.S. Bureau of Public Roads and as principal assistant engineer in charge of sewer and waterworks construction in Manila.

Robert E. Oakley (A.M. '47; M. '59), age 54, was professor of engineering at the Yakima Valley Junior College in Yakima Wash. During the 20-year period preceding his associaton with the Junior College, he served as a civil engineer with the Utah Construction Company on bridges, trestles, trusses and foundations which formed part of the Davis Dam project on the Colorado River; and as hydrographer and assistant highway engineer with the Fresno Irrigation District of the California Highway Department.

Carter Laurence Shea (M. '53; F. '59), age 45, in recent years was senior project engineer with the Shell Oil Company, engaged in the construction of pipeline and terminal facilities for the area east of the Rockies. Previously he had been an engineer with the Frederick Snare Corporation where he had charge of constructing breakwaters and drydocks in the Panama Canal Zone.

Francis M. Tompkins (M. '51; F. '59), age 52, was president of Tompkins, Inc., his own engineering consultants firm in Washington, D.C. Mr. Tompkins, a former senior vice president of the Charles H. Tompkins Company, founded by his late father and sold this past year to the J. A. Jones Construction Company, was also a consultant in the building industry.

News of Members

(Continued from page 27)

Joseph F. Friedkin, appointed recently as commissioner of the United States Section of the International Boundary and Water Commission, was lauded by Senator Ralph Yarborough of Texas as "an engineer of nationally recognized ability and service." Mr. Friedkin, one of the leaders in working out the division between the United States and Mexico of waters of the Rio Grande and Colorado River under a 1944 water treaty with Mexico, prior to his promotion was principal supervising engineer in the United States Section. In 1958, he was named Civil Servant of the Year by the Federal Business Administration.

M. H. Cutler recently retired as vice president and engineering manager after 37 years' service with the Stone & Webster Engineering Corporation, of Boston, Mass., and New York, N.Y., Mr. Cutler was previously assistant engineering manager and chief structural engineer with the firm.

William Travis Walker, after three years as chief engineer for the Nantahala Power and Light Company, a subsidiary of Alcoa, at Franklin, N.C., was promoted recently to vice president in charge of engineering. He joined Alcoa in 1937, serving in the Power Division from that year until 1954, first as assistant superintendent and then as superintendent of the Hydraulic Department. Following this assignment he bacame general manager of the Chilhowee hydroelectric development in East Tennessee.

Vincent J. Kovarik in his new post as field engineer for the St. Louis plant of the W. S. Dickey Clay Manufacturing Company, of Kansas City, Mo., will work primarily with engineers, municipal officials and contractors. Mr. Kovarik joins W. S. Dickey from the Massman Construction Company, where he was a construction engineer. Prior to this, he was for several years an engineer with the Missouri Highway Department.

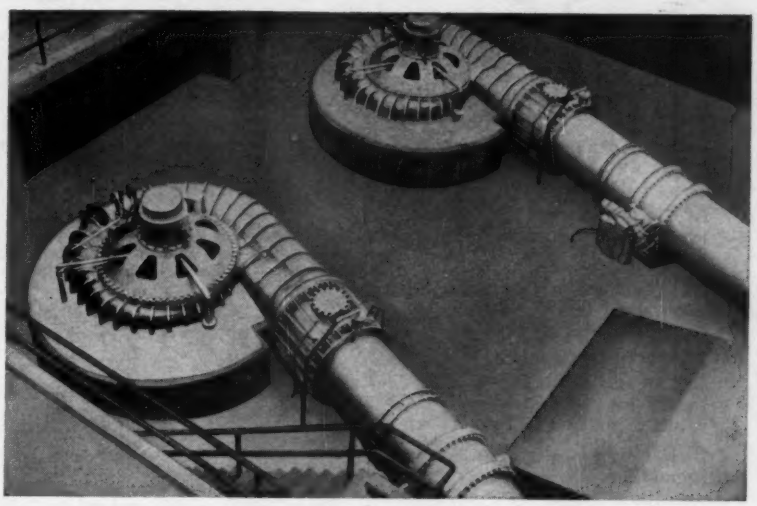
William R. Gray has opened structural and civil engineering offices at 8605 Mentor Avenue, Mentor, Ohio. In eight previous years as chief structural and civil engineer with McGeorge, Hargett and Hoag he participated in numerous projects, such as the new 23-story Illuminating Company building at the Cleveland Public Square and a number of new buildings at Case Institute of Technology.

Charles M. Romanowitz, internationally-known dredging expert, has opened a consulting office at 2034 Santa Clara Avenue, in Alameda, Calif. For nearly 40 years he was responsible for recommending and installing all dredges for the Yuba Manufacturing Company, followed most recently by three and one-half years as division sales manager with the Ellicott Machine Corporation, where he will continue as a consulting engineer.

Robert C. Blair, at the present time manager of the Savannah River Operations Office of the U.S. Atomic Energy Commission, was named "Engineer of the Year," on June 17 by the South Carolina Society of Professional Engineers. He became manager of the Operations Office in 1955 after five years as its deputy manager.

William L. Miller, newly appointed Edwardsville (Ill.) city engineer, was formerly a member of the Edwardsville firm of Sheppard, Morgan and Schwaab. This had been preceded by four years with Sverdrup & Parcel of St. Louis during which time he was active in the design of a nine-span, $3,000,000 railroad bridge, and by two years with the DuPont Construction Division in Augusta, Ga., specializing in concrete building construction.

Alden K. Sibley, Brigadier General with the U.S. Army Corps of Engineers, has a new assignment as deputy chief of Engineers for Military Operations in the Washington, D.C., office of the Chief Of Engineers. He was most recently deputy chief of staff of the Logistics Branch of the Military Assistance Advisory Group to Vietnam. General Sibley has been nominated by the President for promotion to Major General.



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Non-ASCE MEETINGS

American Association of State Highway Officials. Regional Conference on Improved Highway Engineering Productivity, co-sponsored by the Bureau of Public Roads, the Massachusetts Department of Public Works and engineering schools in the Boston area, at the Somerset Hotel, Boston, Mass., August 24 and 25, 1961.

American Institute of Electrical Engineers. Pacific General Meeting at the Hotel Utah, Salt Lake City, Utah, August 23-25, 1961.

American Public Works Association. Annual Public Works Congress and Equipment Show at the Municipal Auditorium, Minneapolis, Minn., September 24-27, 1961.

American Society of Mechanical Engineers and American Institute of Chemical Engineers. Co-sponsors of the International Heat Transfer Conference at Boulder, Colo., August 28-September 1, 1961.

American Society for Metals. Forty-third National Metal Congress and Exposition in Cobo Hall, Detroit, Mich., October 23-27, 1961.

American Society of Photogrammetry. Semi-annual convention and technical exhibit at the Biltmore Hotel, New York, N.Y., October 4-6, 1961.

American Standards Association. Twelfth National Conference on Standards at the Rice Hotel, Houston, Texas, October 10-12, 1961.

American Welding Society. Fall meeting at the Adolphus Hotel, Dallas, Texas, September 25-28, 1961.

Engineers' Council for Professional Development. Twenty-ninth annual meeting at the Sheraton Seelbach Hotel, Louisville, Ky., October 2 and 3, 1961.

Industrial Building Exposition and Congress. Second annual meeting produced by Clapp & Poliak, Inc., exposition management firm, at the Coliseum, New York, N.Y., September 25-28, 1961.

Institute of Traffic Engineers and International Sessions in Traffic Engineering. World Traffic Engineering Conference, combined meeting in Washington, D.C., August 21-26, 1961.

International Association for Hydraulic Research. Ninth congress in Belgrade, Yugoslavia, September 3-7, 1961. Write to H. J. Schoemaker, c/o Waterloopkundig Laboratorium, Raam 61, Delft, Netherlands.

National Council of State Boards of Engineering Examiners. Annual meeting at the Hotel Buena Vista, Biloxi, Miss., August 23-26, 1961.

National Safety Council. Annual meeting at the Conrad Hilton Hotel, Chicago, Ill., October 16-21, 1961.

Prestressed Concrete Institute. National convention will be held in cooperation with the University of Colorado in Denver, Colo., October 15-19, 1961.

Standards Engineers Society, Inc. Tenth annual meeting at the Hotel Sherman, Chicago, Ill., September 18-20, 1961.

Water Pollution Control Federation. Thirty-fourth annual meeting in Milwaukee, Wis., October 8-12, 1961. Headquarters will be the Hotel Schroeder.

Western Building Industries Exposition. First annual exposition at the Great Western Exhibit Center, Los Angeles, Calif., October 7-10, 1961.

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DANIEL BEATON, New York, N.Y.
OREN HERBERT BELLIS, Louisville, Ky.
DAILEY JOSEPH BERARD, Houma, La.
ARTHUR ROWLAND BEVAN, Salmon, Idaho
KENNETH ARTHUR BOND, North Sydney, Australia
JOHN EBERTH BRINK, Iola, Kans.
HASKAL BROCINER, Chicago, Ill.
HENRY ROBERT CALLAGHAN, Anaheim, Calif.
GEORGE PRINTISS CAMPBELL, New York, N.Y.
FRANCIS JAMES CAROLAN, Indianapolis, Ind.
BIRENDRANATH N. CHAKRAVARTY, Wad Medani, Sudan
DAVID HENRY COMANN, Des Moines, Iowa
JAMES WINFORD CRAIG, San Diego, Calif.
RICHARD GLEN DINNING, Oakland, Calif.
PAUL ORVILLE ERICKSON, China Lake, Calif.
ROY FRANCIS FERGUSON, Rolla, Mo.
LESLIE RAYBURN FLEMING, Birmingham, Ala.
JOHN ROBY GOODWIN, Plattsburgh, N.Y.
ROLAND RUSSELL GRAHAM, JR., Pittsburgh, Pa.
ROBERT WILLIAM GREEN, Jacksonville, Fla.
YVES JEAN HALLER, Montreal, Quebec, Canada
FRANK WILLMORE HAWS, Logan, Utah
ELMER LINCOLN HAYNES, Quito, Ecuador
EDWARD CHARLES HELMES, Boston, Mass.
LESLIE LEIGH HUNT, Dallas, Texas
V. SUBRAMONIA IYER, Kerala, India
JONATHAN LEROY JARRETT, Angola, Ind.
FREDERICK KEITH JOLLS, Cedar Grove, N.J.
NORMAN RICHARD KERGAARD, Los Angeles, Calif.
ERNEST CHARLES KOBS, JR., Houston, Texas
WILLIAM CONRAD KOSKINEN, Seattle, Wash.
LELAND MILO KRAFT, Wadsworth, Ohio
PULLARCOT ANCHAKALVAN KUMARAN, Kerala, India
SAILESH MAJUMDER, Wad Medani, Sudan
DOUGLAS JOHN MCKELVIE, Awali Bahrain
DONALD WILLIAM MCNAMARA, Cranston, R.I.
VLADIMIR UNGERN MINORSKY, New York, N.Y.
WALLACE E. MITSVEN, Kansas City, Mo.
JOHN DIDSBURY MOSS, Palo Alto, Calif.
ZEIN ABDIN MUSTAFA, Khartoum, Sudan
WILLIAM DUNN NG, Honolulu, Hawaii
GERALD FRANCIS O'BRIEN, JR., Tulsa, Okla.
MATTHEW BERNARD O'GARA, Sacramento, Calif.
LESLIE VERNON OLSON, Downey, Calif.
WENDELL RAYMOND ORNDORF, Dallas, Texas
STEPHEN PAVELKA, New York, N.Y.
LUNSFORD CLAY PITTMAN, Chicago, Ill.
WAYNE DOYLE POTTER, Jackson, Mich.
ROBERTO PROSDOCIMI, Kuwait, Arabian Gulf
SERGIO ANTONIO SAYAGO, Bethlehem, Pa.
BRUCE LEWIS SCHWARTZ, Denver, Colo.
BURTON ALCOTT SCOTT, Atlanta, Ga.
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BACHAN SINGH SERAY, Calcutta, India
VIRGIL DENSON SKIPPER, Atlanta, Ga.
EDWARD ISAAC SHAVIT STREIFLER, New York, N.Y.
WILLIAM SUCH, Houston, Texas
DOUGLAS BROWNE THOMPSON, London, England
JAMES KELLY TOWNSEND, Providence, R.I.
DENNIS TRIMAKAS, Chicago, Ill.
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Applying for Affiliate

FLOYD RACE JONES, Philadelphia, Pa.
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JOHN HENRY WICKHAM, JR., Jenkintown, Pa.

Applying for Associate Member

ROBERT CAVE ADAMS, Dallas, Texas
DONALD ROBERT ANDERSON, Torrance, Calif.
KALAKOTI SADASIVA VENKATA BASIVI REDDY, Andhra State, India
DOUGLAS NORMAN BETTS, Great Falls, Mont.
JOHN GOWER BEVAN, Nigeria, West Africa
TED EUGENE BISHOP, Findlay, Ohio
SATYENDRA MOHAN GUHA BISWAS, Calcutta, India
ANDERS NILS BRETTE, Goteborg, Sweden
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CARL RAY JOHNSON, St. Albans, W. Va.
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MUHAMMAD SARFRAZ KHAN, South Wales, Great Britain
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DONALD EDWARD MANN, Dayton, Ohio
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IAN CHAPMAN O'NEILL, Minneapolis, Minn.
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DONALD JOE RAWLINGS, Pekin, Ill.
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GABRE AMLAK TEODROS, Evanston, Ill.
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A scientific approach to soil and foundation problems is stressed, and the theories applicable in situations that engineers are likely to encounter in practice explained. Over two-thirds of the text has been rewritten in this edition, which emphasizes the importance of mineralogy, physico-chemical forces and structure, and their relation to shear strength, consolidation, compaction, and soil stabilization. The newer concepts of bearing capacity of shallow foundations and of piles are also treated. (By George B. Sowers and George F. Sowers. The Macmillan Company. 60 Fifth Avenue, New York, N. Y., 1961. 386 pp., bound. $8.00.)

Selected Papers on Stress Analysis

Includes eighteen papers dealing with methods of stress analysis and their application which were presented at the Institute of Physics, Stress Analysis Group Conference held at Delft in 1959. They are given in the form in which they were presented, in English, French, or German, together with summaries in the three languages of the conference. An English résumé is given for thirty-three papers also given at the conference, but which are not included in the volume. (Published by Chapman and Hall, London, England, 1961. 114 pp., bound. 50s.)

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Shear Stresses at Column Heads in Flat Slabs

A simple procedure is developed for determining the unit shear stresses at column heads in flat plates. The procedure is adaptable to any problem pertaining to shear stress computations at column heads in flat slab, including lift slab framing, and at column bases for foundation mat construction. (By Willy K. Hahn. Published by author, 8501 Carroll Avenue, Silver Spring, Md., 1961, 48 stencilled pages, paper. $5.00.)

Simplified Engineering for Architects and Builders

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A guide to the determination of the proper size of every-day structural numbers. This edition has been rewritten to conform with the current allowable unit stresses and specification requirements, and includes many new technical problems, tables, and figures. The abbreviations for scientific and engineering terms have been brought into agreement with the recommendations of the American Society of Mechanical Engineers. The major portion of the book is devoted to the solution of practical problems dealing with mechanics, timber construction, steel construction, reinforced concrete construction, and roof trusses. (By Harry Parker. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1961, 325 pp., bound. $7.00.)

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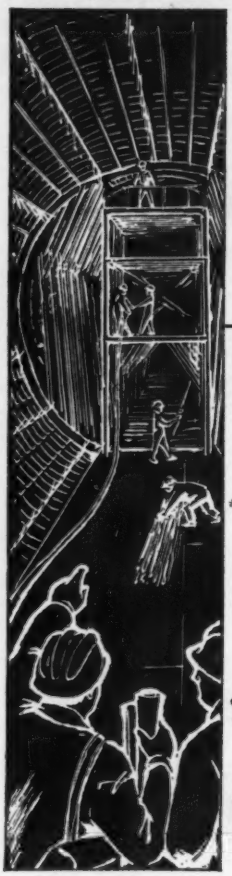

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Reinforced Concrete Piling
Second Edition

This is the second edition of a work aimed at describing current British practice in designing, manufacturing and driving reinforced concrete piles. Additions and revisions include material on the bearing capacity of piles, loading tests, sheet-pile retaining walls, specifications and quantities. Reference is made to Civil Engineering Code of Practice no. 4, "Foundations" (1954), prepared by the Institution of Civil Engineers. Charts giving the reinforcement in piles in accordance with this Code are now included. Prestressed concrete piles are not dealt with, but the chapter on piles cast in place has been extended. Several new examples of piled wharves, and jetties and fenders have been included. (By F. E. Wentworth-Sheilds and others. Concrete Publications Ltd., London, England, 1960. 149 pp., bound. $4.00.)

Stability of Coastal Inlets

This is a report on current efforts towards effecting engineering control of the problems of coastal inlets—shore protection, stabilization of navigable channels, and maintaining and increasing their depth. The authors are affiliated with the Coastal Engineering Laboratory of the University of Florida. After introductory chapters giving background, origin, and natural "behavior" of tidal inlets, the authors discuss tidal hydraulics and its effects; such inlet stability factors as flow, shape, bottom soil conditions, sediment load, and littoral drift; the analysis of actual inlet data; and the design of tidal inlets for maximum operating efficiency. (By P. Bruun and F. Gerritsen. North-Holland Publishing Company, Amsterdam, The Netherlands, 1960. 123 pp., paper. $3.00.)

Standard Methods for the Examination of Water and Watershed
Eleventh Edition

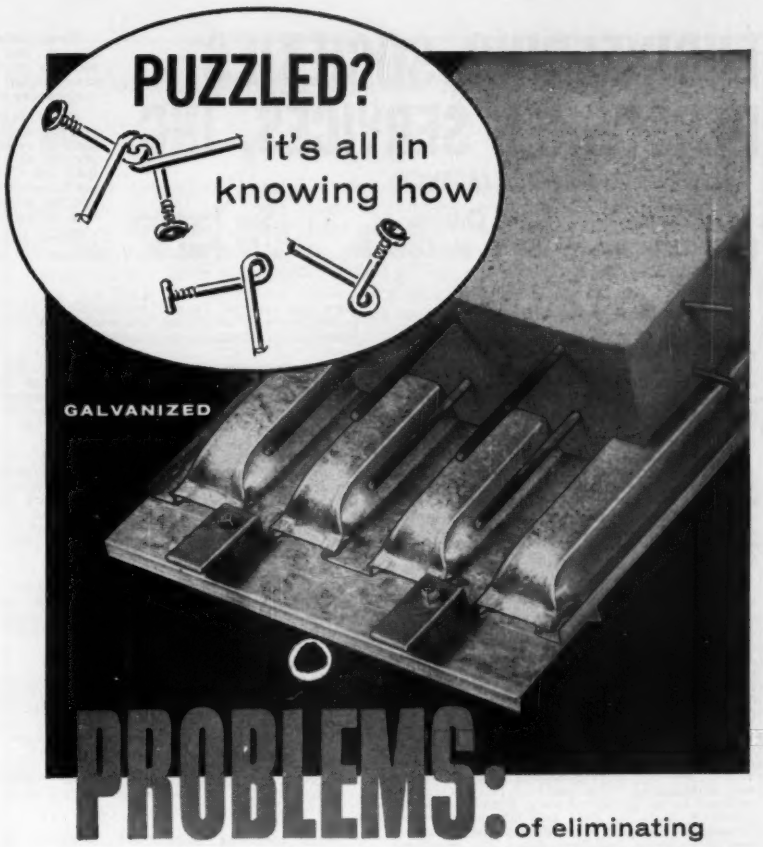
A new "General Introduction", containing information of importance to the proper execution of the procedures described in the manual, and a section on the statistical treatment of data, opens this edition. Three new sections also have been added, dealing with procedures for the measurement of radioactivity in water and wastes, the taxonomy and physiology of iron and sulfur bacteria, and bioassay methods for toxicity evaluation. Numerous revisions also have been made in the remaining six sections of the book, which deal with physical, chemical, bacteriologic and biologic examination of waters, wastes and sludge and bottom sediments. (Published by American Public Health Association, Inc., 1790 Broadway, New York 19, N. Y., 1960. 626 pp., bound. $10.00.)

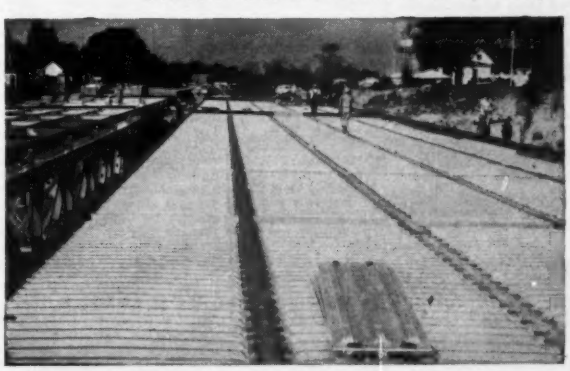
Turbulence

A collection of papers which represent significant advances in the development of the statistical theory of turbulence. The papers encompass the period from 1921 to 1950, and in addition to treating the subject in its broad aspects cover such special aspects as diffusion by continuous movements, the statistical theory of isotropic turbulence, the spectrum of turbulence, the local structure of turbulence in incompressible viscous fluid for large Reynolds numbers, the degeneration of isotropic turbulence in an incompressible viscous fluid, dissipation of energy in locally isotropic turbulence, and the concept of similarity in the theory of isotropic turbulence. (Edited by S. K. Friedlander and Leonard Topper. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y., 1961, 187 pp., bound. $6.00.)

Welded Interstate Highway Bridges

The award winning designs of The James F. Lincoln Arc Welding Foundation's 4th (1958) bridge design competition, represent a cross section of the best current practice in bridge construction for the Defense and Interstate Highway System. By now many of the bridges have been built, while others are in various stages of erection. The introduction describes the award programs and gives the 1958 winners and summarizes their designs. The remaining chapters each take up one aspect of bridges—plate girders, arches, box girders, and bascule—with text, photographs, and reproductions of the drawings and specifications by the award winners. (Edited by James G. Clark. The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio, 1960. 269 pp., bound. $2.00.)





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If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

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OFFICE OR ADMINISTRATIVE ENGINEER, F. ASCE, Registered N.Y., Colo., Va., certified by NCSBEE. Experience includes 10 years of heavy administration and 17 years of highway and airport design and construction. Desires supervisory office position. Location, Foreign or Domestic, except New York City and Chicago. C-701.

PROJECT ENGINEER, M. ASCE, speaks Spanish, German, Persian. Wide experience in civil works, port and harbor development, all phases administration, and management. Also structural design, reinforced concrete, and steel structures. As regional manager acted as liaison for consulting engineers-architects in Middle East on community development projects. Salary, $12,-000. Presently located in Iran. Will relocate. C-703.

FOUNDATIONS AND MATERIALS ENGINEER, M. ASCE; Reg. P.E., M.S. in Soils Mechanics and Foundation Engineering; second M.S. in Highway Engineering. Nine years of responsible experience in all phases of soils, foundations and materials, including field and laboratory work. Diversified background in design and construction of highways, buildings, dams, etc., specifications and reports. Desires responsible position preferably with consulting engineers. Available immediately, Domestic or Foreign. C-704.

CIVIL ENGINEER, F. ASCE, P.E., N.Y., B.S. and M.S. in C.E. Ten years of experience in design and administration of soils, structural and civil works, electronic computation and reports. Salary, $13,000. Location, U.S. C-705.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 32. As project engineer for four years was responsible for planning and construction of medium sized masonry buildings and steel towers in multi-state area. Also experienced in contract negotiations and supervising contractors and inspectors. Salary, $9,000. Location, Southwest, West or Midwest. C-2214-Chicago.

CONSTRUCTION SUPERINTENDENT, A.M. ASCE, B.S.C.E., 30. Seven years in construction, including both office and field work for general contractor, architect and owner. Salary, $10,000. Location, U.S. C-2215-Chicago.

PROFESSOR, DEPARTMENT HEAD OR PLANNING ADMINISTRATOR, A.M. ASCE, Reg. C.E., B.S.C.E., M.S.C.E., Ph.D., 38. Ten years of teaching experience in highways, traffic, city planning and other civil engineering courses, with direction of research project in city planning; one year bridge design and two years supervising interstate design. Also land planner and coordinator of development of 300 acres. C-2216-Chicago.

FIELD ENGINEER, A.M. ASCE, B.S.C.E., 34. As engineer for a paving contractor work included quantity take off and setting lines and grades. Additional experience includes one and a half years with a consulting engineer working on design of a storm sewer system and eight years with U.S. Government on roadway design and construction. Salary, $9,600. Location, Midwest or West. C-2217-Chicago.

CONSTRUCTION ENGINEER, M. ASCE, Reg. P.E.-Ill., B.S.C.E., 35. Spent ten years with the Corps of Engineers, of which two years involved field inspection on building and heavy concrete construction, three years as assistant chief in the contract administration branch, and five years as project engineer for the Air Force. Salary, $12,-000. Location, Chicago area. C-2218-Chicago.

SALES AND CORPORATE MANAGEMENT, M. ASCE, P.E., B.S.C.E., M.S. Public Health, 43. Private water and sewage sales, financing, construction and operation. Four years as national sales manager for sewage treatment plants. Followed by four years as vice president of chemical sales. Desires challenging sales position with management potential. Salary, $15,000-$18,000. Location, Midwest, Southwest. C-2219-Chicago.

OFFICE ENGINEER OR MANAGEMENT, A.M. ASCE, P.E., B.S.C.E., two years of Law, 27. One and a half years' experience in steel design of power plant for consultant and one and a half years' experience as field engineer for contractor. Salary, $6,600. Location, Chicago. C-2220-Chicago.

PROJECT MANAGER, M. ASCE, C.E., 44. Twenty-one years of diversified field, design, and general engineering experience. Plus five years as project design manager. Salary, $11,000. Location, San Francisco Bay Area. Se-1867.

CONSTRUCTION SUPERVISOR AND APPRAISER, F. ASCE, C.E., 51. For three years planned and directed the construction of various maintenance, management, and fire prevention facilities. This experience was supplemented by one year directing construction program for explosives plant and two years of general supervision over military construction such as airfield pavement, hangars, pipeline, steam power plant, sewage treatment and water plants, and air warning systems. Salary, $10,000. Location, Western United States. Se-883.

STRUCTURAL DESIGNER, M. ASCE, C.E., 46. For 20 years was structural designer of all types of heavy and light industrial and commercial structures employing steel, reinforced concrete and timber. Salary, $850-$900. Location, San Francisco Bay Area. Se-1562.

STRUCTURAL ENGINEER, A.M. ASCE, C.E., 33. In six years as structural engineer and project engineer in the chemical industry gained experience drafting, doing material take off and preliminary design of chemical plant structures. Salary, $9,000. Se-763.

FIELD ENGINEER, A.M. ASCE, C.E., 32. Seven years of experience in field inspection and testing major process units, vessels and piping codes, as maintenance engineer of process units and power house, making estimates and directing building construction and maintenance. Additional experience in quarry and demolition work and in framing and finishing carpentry on small homes. Salary, $9,000. Location, Western U.S. or foreign. Se-1310.

STRUCTURAL ENGINEER, M. ASCE, C.E., 32. Two years of experience in subdivision development designs and construction, large oil camps, planning and scheduling men and equipment for maintenance and construction for refinery. Experience in inspection and supervision of all structural steel erected for paper mill. Salary, $8,500. Location, Western U.S. or foreign, Se-1294.

Positions Available

CIVIL ENGINEER, professional registration, 50-60. Experience should include employment with nationally known firm of consulting engineers and direct participation in both design and supervision of construction of modern highway projects of interstate standards. Entire career should be one actively engaged in engineering work. Salary open. Must be resident of New Jersey as this is job location. W-627.

SALES ENGINEER for the New York City area, preferably civil graduate, 25-35, with some sales experience in concrete construction or heavy industrial sales to architects, engineers and contractors on building materials. Salary plus car. W-503.

CIVIL ENGINEERS, for related work in highway and bridge construction and maintenance in Upstate New York. (*a*) Junior engineer, graduate of an accredited engineering school; (*b*) Mature engineer who is licensed. W-500.

FIELD LABOR RELATIONS MANAGER with six to ten years' experience in construction and field labor relations, capable of dealing with building construction trades unions on local and international level. Background in local and international union negotiations with special experience in settling jurisdictional disputes as well as other types of grievances with building trades unions. Apply by letter giving salary requirements. Western U.S. W-492.

ESTIMATOR-FIELD ENGINEER, graduate civil, 25-35, with several years' experience on estimating and field engineering for a general contractor of New York City specializing in industrial buildings, motels and the like. Salary, $8,000-$10,000. W-482.

ASSISTANT PROFESSOR, graduate civil, with two to five years of field and office experience in highway design construction and survey to teach course in highway construction in the New York suburban area. Teaching experience highly desirable. Qualified to teach surveying, highway plan reading, highway drafting and layout, highway design. Salary, $6,470-$8,080 on a ten-month academic year; extra compensation for evening school instruction. W-476.

JUNIOR CIVIL ENGINEER, graduate, 25-35, with some experience in building construction, for evaluation and on spot estimating for New York City insurance company. Should have knowledge of construction costs. Salary, to $7,500. W-472.

BOROUGH STAFF ENGINEER, registered civil engineer in Pennsylvania, with experience in engineering, layout, construction of highways, and sewers for a rapidly expanding Western Pennsylvania municipality. Must be a working engineer, qualified and able to do all work from preliminary plans to the completed project. W-470.

THE STATE OF ALASKA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

Announces an Open Competitive Examination for

Bridge Design Engineer IV

SALARY: Salary range including cost-of-living differential for the above class of positions is as follows: $1,035.00 per month in Juneau area

LOCATION: The present vacancy is in Juneau.

JOB DESCRIPTION: Directs and administers the activities of the Bridge Design Section of the Division of Highways with responsibility for the design of all bridges, culverts and special drainage structures. Must have the combination of technical competence and administrative skill to handle the scale and scope of this position.

QUALIFICATIONS: Ten years of experience in professional engineering bridge design including three years of supervisory experience, college graduation with an appropriate major or an equivalent level and type of experience and a registered professional engineer eligible for Alaska registration.

PURPOSE OF EXAMINATION: To provide qualified persons with an opportunity to compete for present vacancies and for future anticipated vacancies.

APPLICATION PERIOD: Applications will be accepted until further notice.

METHOD OF APPLICATION: File an application with the Director of Highways, Department of Public Works, Box 1841, Juneau, Alaska.

LIBERAL ANNUAL AND
SICK LEAVE BENEFITS
GROUP HEALTH INSURANCE
RETIREMENT AND SOCIAL SECURITY

ASSOCIATE PROFESSOR of civil engineering, with a major in sanitary engineering. Southern school has excellent facilities for instruction and a very active research organization. Opportunity to participate in research. W-439.

MATERIALS ENGINEER, graduate C.E., with considerable experience in soils and materials testing, design of mixes, exploration for construction materials, etc., will be directly responsible to Chief Utilities and Engineering Division Maintenance and Operator Contractor. Salary, $7,500-$10,500 depending on experience. New Mexico. C-8720.

ENGINEERS. (*a*) Sales manager, graduate architect or civil engineer, to 45; with five or more years' experience in sales management, selling building products. Some travel within a 100 mile radius. Salary, to $12,000 depending on experience. (*b*) Office and field sales engineer, with five or more years' experience with structural fabricator, three of which should have been in sales. Preferably registered structural engineer. Salary, $8,000-$12,000 depending on experience. For a fabricator in North Indiana. Employer will negotiate placement fees. C-8715.

ASSOCIATE RESEARCH ENGINEER, structural engineering, C.E., to 40; will engage in studies of structural behavior of conventionally reinforced and prestressed concrete building components and assemblies exposed to fire for a research lab in North Shore Chicago Suburb. Responsible for design of prestressed or conventionally reinforced structural concrete test units and assemblies and design of instrumentation. Some travel. Salary to $10,000. Employer will negotiate placement fee. C-8702.

CHIEF ENGINEER-STEEL FABRICATOR, graduate C.E. or structural, 40 to 50; with five or more years' experience with steel fabricator on detailing, design and sales. Duties will include supervising engineering department, responsibility for detailing and erection drawings for commercial buildings, institutional buildings and bridges for a steel fabricator in Indiana. Will also be responsible for sales and customer contact. Must be registered structural engineer. Salary, $12,000-$15,000. Employer will pay fee. C-8146.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

CHIEF STRUCTURAL ENGINEER, C.E. plus structural license and California registration, to 45. Qualified as top man in a five to six man structural office and completely knowledgeable in steel, wood, concrete from foundation to final design plans and specifications in San Francisco Peninsular area. Salary, $1,000 per month plus incentives. West Coast applicants only. Apply by letter of application. Sj-6254.

DESIGNER OF EARTH FILL DAMS, C.E., about 50 with minimum of fifteen years of experience in the supervision and design of major earth fill dam projects. For a San Francisco engineering-consultant firm. Salary, $10,000-$12,000. Sj-6285.

CITY ENGINEER, C.E. major plus California registration, to 50. Five years of recent administrative or supervisory civil engineering experience, including three years in municipal public works department to plan, coordinate and direct public works; to confer with engineers, contractors, and public agencies; to prepare budget and control expenditures. Will represent expanding Southern California city; supervise plans, specifications, contracts for construction, approve maps and improvement plans. Limited to U.S. citizen. Sj-6234.

SANITARY DESIGNER, C.E. plus advanced study in sanitary, to 50 with minimum of eight to ten years of practical experience in dealing with feasibility studies, consulting and engineering services, and design and professional counsel to clients on water treatment, sewage and sewers. Must also be able to direct, layout work and supervise other employees for a well established consultant in Northern California. Salary, $10,000-$12,000. Sj-6202.

OFFICE ASSISTANT, C.E., 25-35, to work in Alameda County. Preferably with two years' experience laying out and detailing reinforced concrete pipe for sewers, drains or culverts. Able to work on board and assist with engineering—promotion to checker, then office engineer on applications. Salary $600-$650 per month. Sj-6235.

STRUCTURAL DESIGNER. Recent graduate with building background and preferably two years of experience in residential work employing wood frame plus some steel and concrete, will design and draft wood frame buildings for residential and small apartments for a consultant in San Francisco. Must be familiar with tall building construction and code requirements. Salary, $3.50-$4.50 per hour. Sj-6266.

SANITARY ENGINEER II needed by STATE OF ALASKA

Salary: $840—$1005 per month

THIS POSITION has responsibility for planning program and activities in field of waste disposal and water resources management for State Health Agency. Program content and scope is coordinated with Federal Water Pollution Control activities and takes part in State phase of Federal WPC Construction Grant program. Position is responsible for field surveys and reporting on water quality for the State, for inspection and enforcement in pollution problems on State level and coordinates and consults with local level health agency activities in waste disposal problems.

IT INVOLVES consultation with professional engineering concerns on design and operation of treatment facilities for municipal sewage, industrial wastes, and State and Federal Government installations including facilities for radioactive wastes.

THE POSITION carries out plan review activities for these facilities and should also include promotion for or active research work on special problems.

Requirements: Graduation from college with engineering degree; registered professional engineer eligible for Alaska registration; six years of experience in professional sanitation engineering.

Civil Service Position—Retirement Benefits—Annual and Sick Leave

Write AIR MAIL to: Personnel Officer
Alaska Department of Health and Welfare
Alaska Office Building
Juneau, Alaska

RESEARCH ENGINEERS

MECHANICS AND STRUCTURES

Challenging opportunities exist in Applied Mechanics and Structures for creative and imaginative research engineers. These positions offer an opportunity to work in small project groups in an intimate environment with some of the leading engineers in this field. We need men experienced on research problems in one or more of the following areas:

PROTECTIVE CONSTRUCTION	CONTINUUM MECHANICS
STRUCTURAL DYNAMICS	VIBRATIONS
ELASTICITY	VIBRATIONS AND SHOCK
PLASTICITY	MINIMUM WEIGHT DESIGN
THERMOELASTICITY	SOIL DYNAMICS

These positions are non-routine and require men with initiative and resourcefulness. Advanced degree in Mechanical Engineering, Civil Engineering or Applied Mechanics preferred. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

Excellent employee benefits including tuition free graduate study and a liberal vacation policy. Please send resume to E. B. Beck.

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EQUIPMENT, MATERIALS and METHODS

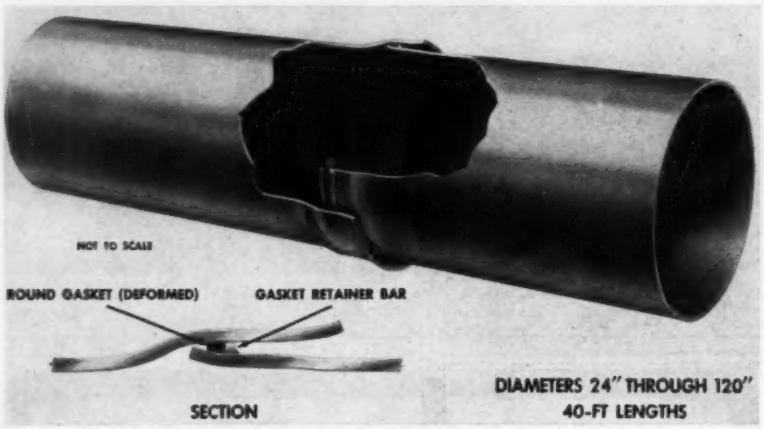
NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Rubber Gasket Joint

THIS TYPE OF PIPE JOINT, widely used in the Far West, was recently introduced in the East and Midwest. To point out the advantages of this pipe joint, a test demonstration for city and waterworks officials and engineering representatives was set up at Steelton, Pa.

Two lengths of 109-in. diameter steel pipe were connected with the bell and spigot rubber gasketed joint, commonly called an O-ring joint. Although the test section was then subjected to a hydrostatic test of more than double the normal test pressure for pipe of this size, no leakage occurred.

With the successful testing of the 109-in. joint, similar tests were made on a 36 in. diameter joint. In this case two standard 40 ft lengths of pipe were joined, just before placement on the testing stand, so observation could be made as to how quickly and easily this type of field connection could be made. Test results showed that the new joint is equally effective on this smaller pipe. **Bethlehem Steel Company, CE-8, Steelton, Pennsylvania.**



Bell and Spigot Joint

Concrete Plane

EQUIPMENT DEVELOPMENT COMPANY, INC. announces a gasoline powered, heavy duty unit, called the EDCO Concrete Plane. It is designed to remove excess concrete and asphalt from slabs, roadways, bridge surfaces, airport runways, parking lots, etc. A series of high carbon adjustable steel cutters, rotating at high speed, will remove a traffic line or "cut" the surface of a slab ½ in. deep and 5 in. wide. It is used to remove high spots, high joints and excess joint sealer compounds on highways and airport runways. It will also erase traffic lines on roads and parking lots. **Equipment Development Company, Inc., CE-8, 2700 Garfield Avenue, Silver Spring, Maryland.**

Yumbo

THIS VERSATILE ALL-HYDRAULIC hoe-loader-shovel is manufactured in crawler and wheeled models with a wide range of working attachments. The patented high-torque hydraulic motor swing arrangement and the 50 ton enclosed double row ball bearing turntable provide continuous rotation in either direction with no "dead-spot", permitting easy access to digging and loading. Yumbo Model 35 offers a compact, powerful, rough-terrain crawler with an unusually low ground pressure. It features a high-torque piston type hydraulic motor, driving each track independently, eliminating the entire conventional center pin drive and steering mechanism. The crawler also features sealed lifetime tapered bearings in track rollers. **Hydraulic Equipment and Shovel Company, CE-8, Bank of the Southwest Building, Houston 2, Texas.**

Power Trowel

A 36 IN. POWER TROWEL with a choice of 3 or 6 hp gas engines, is available with either 3 or 4 blades. It has an improved type of declutching mechanism, which makes engagement of the blades easier, and gives the operator complete control over the blade operation. The handle of the trowel is longer and adjusts to the height desired by the operator. The stationary guard ring, allows operation of the power trowel close to sidewalls and baseboards, without bounce back. **Muller Machinery Co., CE-8, Metuchen, New Jersey.**

Close Mesh Grating

A MESH GRATING, specially designed for greater strength, retains a high degree of visibility and ventilation, and is easy to maintain. Load-bearing capacity has been increased 60 per cent through use of 36 bars in each standard 2 ft width. Clear opening is ½ in. In addition to the strength acquired through closer mesh of the bars, the grating is still fabricated through an electroforging process. This provides one-piece construction of the bearing bars and cross bars, which are twisted to provide a slightly rough non-slip surface. The grating is also available in a pattern of 37 bars in each 2 ft wide panel (⅜ in. opening between bearing bars); and in other, minimum bar sizes. **Blaw-Knox Company, CE-8, 300 Sixth Avenue, Pittsburgh 22, Pa.**

Aluminum Siding

ALUMINUM SIDING, factory-finished with a smooth, durable, fire-cured vinyl finish, will not peel, crack or chip. It is made of the highest quality aluminum, that will not rot, rust, warp or sag and is available in both insulated and standard horizontal 8 in. clapboards. The insulated siding is 10 ft 8 in. long with a ½ in. butt; the standard siding is 12 ft 6 in. long with a ½ in. butt. The insulated type is laminated with double-beveled ⅜ in. backer board, which increases transverse strength, stiffness and impact resistance over that provided by hollow or plastic foam-backed aluminum siding. **Johns-Manville, CE-8, 20 East 40th Street, New York 16, New York.**

Sewage Ejector

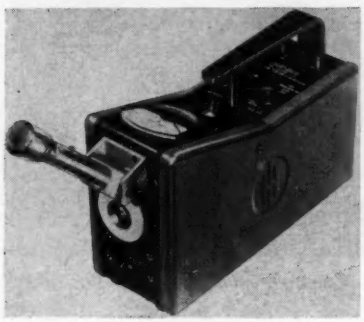
A "NO-FAIL" ELECTRODE SYSTEM, designed to eliminate the major types of failure that occur in conventional electrode systems in sewage ejectors, is composed of a hollow electrode and heavy-duty rectifiers and capacitors that change alternating current to direct current, ultra-sensitive direct current relays and high-accuracy timing units. It operates in the following manner: When sewage fills one of the sewage receivers, the liquid completes the electrical circuit from the single electrode, through the liquid, to the ground at the receiver wall. This energizes the DC relay which operates a three-way air valve and starts an adjustable electrical timer. The timer keeps the three-way valve energized for a predetermined period of time while sewage is ejected from the sewage receiver. When the time cycle is completed, it releases the interlocks that prevent both receivers from ejecting at the same time, permitting the other receiver in the duplex unit to eject when it is filled. **Smith & Loveless, Div.-Union Tank Car Company, CE-8, P. O. Box 8884, Kansas City 15, Missouri.**

Bituminous Compound

A DIFFERENT TYPE bituminous compound is to be used in the manufacture of bituminized fibre sewer and drain pipe. Bituminized fibre pipe is a stable combination of tough cellulose wood fibers completely impregnated with a bituminous compound which renders it impervious to the chemicals and greases inherent in sewage and to the acids and corrosive agents found in the ground. Extensive laboratory tests have demonstrated that the bituminous compound exceeds the quality control test specifications of the U.S. Department of Commerce and the Fibre Pipe Industry. **The Hess-Snyder Co., CE-8, 257 Erie Street South, Massillon, Ohio.**

Noise Measurement

A SOUND LEVEL METER designed to the S1.4—1961 ASA standard, called the Model 412, operates over the exceptionally wide frequency range of 5 cps to 30 KC. A ceramic microphone allows it to be used in temperatures ranging from 0 to 170 deg. F. There is a built-in electro-acoustic calibrator to insure consistent accurate readings at all times. It operates on



Sound Level Meter

two batteries plus a single bias cell and the circuitry includes seven transistors. Design engineers can use the 412 for measurement of noise produced by appliances, machines and automobiles. It will also help determine the acoustical properties of materials, enclosures and rooms. **H. H. Scott, Inc., Instrument Div., CE-8, 111 Powdermill Road, Maynard, Mass.**

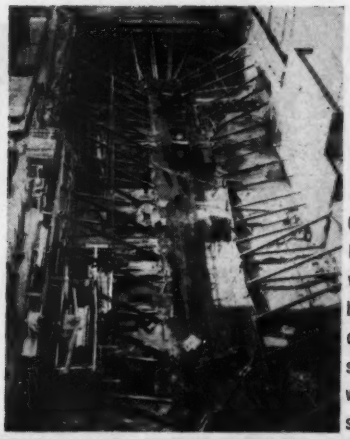
Welding Rod

A SILICON-BRONZE WELDING ROD, designated Airco 1010, is used for welding silicon bronze wrought, cast materials, weldable grades of copper and copper alloys. It is also suitable for use with tungsten inert-gas (Heliweld), carbon arc and oxyacetylene welding processes. The silicon-bronze alloy welding rods come in 36 in. lengths and diameters ranging from 1/16 to 5/16 in. The standard package is a 50 lb carton. **Air Reduction Sales Company, Div. of Air Reduction Co., Inc., CE-8, 150 East 42nd Street, New York 17, New York.**

THIS?

OR

THIS?



Conventional method. Excavation and formwork are encumbered by the raker braces required to support the system of horizontal wood sheeting and soldier beams.

In new method developed by Spencer, White & Prentis, sheeting is supported from the exterior side. Cables are first grouted into sockets in bedrock. These cables are then prestressed by a jacking system and attached to the wales. The tie-back method is thus "pretested" for strength and safety.

Now, Pretest cable tie-backs (Pat. App. for) support wood sheeting from exterior side. New "clutter-free" method proves successful wherever used.

As one installation follows another—with "A-OK" results each time—the Pretest tie-back method gains increasing numbers of friends among construction men everywhere.

This broadening acceptance reflects many factors: the dependable results, the greater safety of the method and the valuable advantages it offers. You have no encumbering braces to contend with. Your free-and-clear work area permits speed and ease of operation not possible before.

Send for job studies which explain the tie-back principle—developed by foundation specialists with over 40 years experience—described by one of the leading construction editors as a "technological breakthrough."

Spencer, White & Prentis INC.

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Foundations Piling Underpinning Shoring Cofferdams Special Services

For positive protection against power failures, install

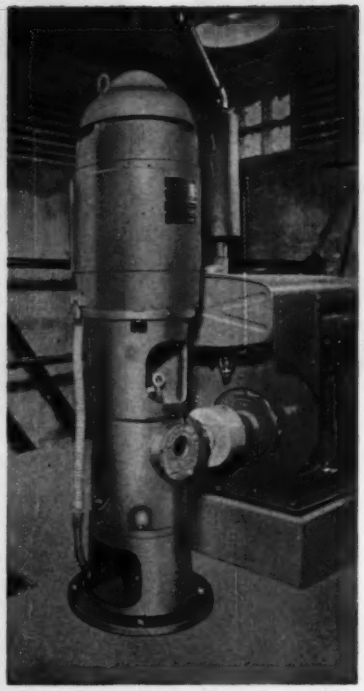
JOHNSON

Right angle

GEAR DRIVES

Cross State Development Co. installed the Johnson combination drive shown here in a sewage disposal plant in Florida. They report: "It's recognized as one of most efficient, packaged systems in the Tampa area. We've never experienced any difficulty." Neither will you because Johnson combination drive assures engine take-over the instant electricity fails. Either power unit may be overhauled without interrupting service.

Sizes: 15 to 450 hp. Johnson Right Angle Gear Drives are available in combination, dual and standard types; for all horizontal prime movers; hollow or solid shaft. Please write for engineering catalogs.



7-R

JOHNSON MAKERS OF FINE GEARS SINCE 1904

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East and Gulf Coast representatives:
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New book tells

Where . . .

How . . .

to place reinforcing bars

Written for bar setters and inspectors . . . as a manual for apprentice courses . . . and a reference for specification writers, architects, engineers, and detailers.

Contains complete specifications and instructions for placing reinforcing bars, welded wire fabric, and their supports.

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Concrete Reinforcing Steel Institute
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Chicago 3, Illinois

TIDE GATES

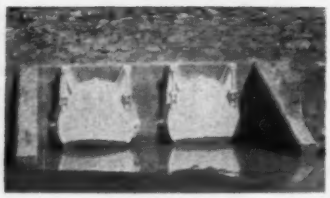


Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

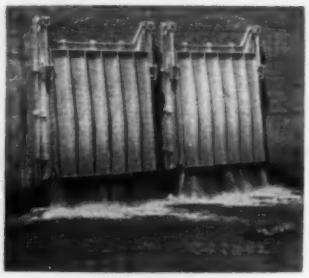


Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

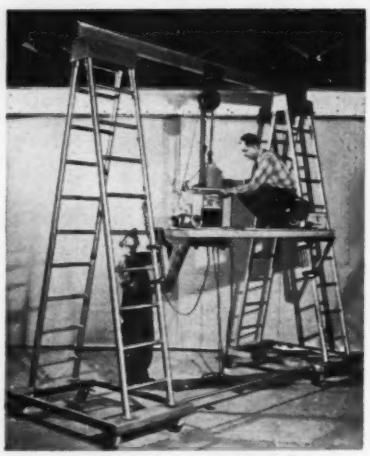
BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

EQUIPMENT MATERIALS and METHODS

(continued)

VersaCrane

THIS CRANE is a completely collapsible unit and is constructed of several independent units in such a way that each section may be used individually when desired. In addition, its platform scaffold may be raised or lowered with all equipment on it. The component sections include: two platform trucks with 4-position lock, ball bearing casters, four independent ladders and an L-beam fixed to the saddles of the two rolling ladders. The crane is equipped with a 1-ton chain block which converts the unit into a Gantry crane. **W. B. McGuire Engineering Co., Ltd., CE-8, P. O. Box 265, Champlain, New York.**



Combination Crane and Scaffold

Heavy-Duty Pipe Pusher

THE HEAVY DUTY POW-R MOLE was designed and developed to push rod in any condition where pushing is possible. It can pull ½ to 3½ in. diameter copper, steel, plastic pipe or tubing, underground, faster, easier and more accurately. It attaches to most standard tractor-mounted hydraulic back hoes, has a 5 in. stroke and operates at a force up to 35 tons. One man can dig the trenches, attach and set up the unit, insert the rod sections and operate the tractor hydraulics. The direction can be reversed by changing the position of the two drag springs without turning the pusher around. The unit comes complete with a full set of cribbing, soft push rod and pusher cap. **Pow-r Devices, Inc., CE-8, Dept. 128, Clarence Center Road, Clarence Center, New York.**

Proved Cost Saver

CURE and SEAL CONCRETE WITH 1 PRODUCT

THOMPSON'S WATER SEAL

Eliminates wet sacks, papers, hosing and spraying

Spray deep penetrating, colorless Thompson's Water Seal on fresh concrete to cure and seal in one operation. Save time . . . save labor.

Effectively controls moisture loss for 28 days and beyond.

Assures uniform curing even in hot, dry weather.

Helps reduce checking, cracking, spalling.

Produces harder, dust-free surface.

Eliminates waterproofing concrete floors.

Permits adequate time for smooth troweling.

Send for technical bulletin and Contractors Case History file.

A proved bond breaker for pre-cast, tilt up and lift slab construction. Permits easy, clean separation of slabs, walls, pre-cast members.

Available in 5 and 55 gallon drums from building supply stores, paint and hardware dealers.

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Thompson's

MANUFACTURERS OF FINE PROTECTIVE CHEMICALS SINCE 1929

E. A. Thompson Co., Inc., Merchandise Mart, San Francisco 3, California

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EQUIPMENT MATERIALS and METHODS

(continued)

Pneumatic Pump

A SELF-CONTAINED PORTABLE pneumatic sump pump has wide application in the removal of sewage, sludge, chemicals, oil, clean or dirty water from sumps, wells, excavations, mines, quarries, ditches, trenches and cellars. The pump body, impeller, and strainer are made of bronze to resist corrosion and to insure spark-free operation. Heavy duty thrust and radial bearings support the two-part,

Portable Sump Pump

non-clogging impeller, which is mounted on a stainless steel shaft. Pump speeds vary between 3200 and 3600 rpm. Bearings are double-sealed to protect the impeller and air motor from contamination or damage by dirt or corrosive liquids. It is 19⅜ in. high and can be passed through a hole as small as 10 x 12 in. Any liquid over 1⅜ in. deep can be picked up while solids over ¾ in. are blocked out by the integral bronze strainer. **Schramm, Inc., CE-8, 900 East Virginia Avenue, West Chester, Pennsylvania.**

After September 5, 1961, ASCE and CIVIL ENGINEERING will be in new offices in the UNITED ENGINEERING CENTER. The new address is:

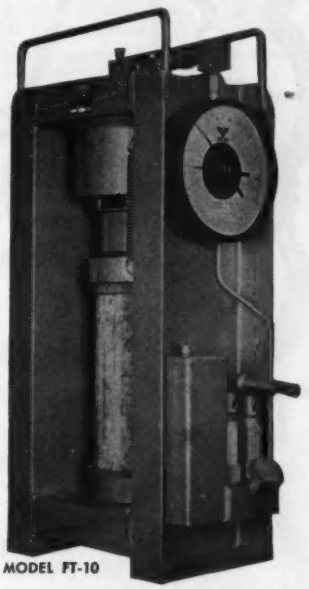
American Society of Civil Engineers
United Engineering Center
345 East 47th Street
New York 17, N. Y.
Telephone: PLaza 2-6800

FORNEY

CONCRETE TESTERS

KNOWN THE WORLD OVER

THE "JOBSITER"



MODEL FT-10

LOWEST priced tester with high priced features

- **250,000 LB. LOAD RATING**
- **DESIGNED TO PROTECT OPERATOR FROM FLYING FRAGMENTS**
- **FULLY PROTECTED GAUGES EQUIPPED WITH INSTANT CONNECTORS**

Accessories available for:

- ★ **6" x 12" cylinders**
- ★ **8" x 8" x 16" blocks**
- ★ **6" x 6" beams**
- ★ **6" x 6" cubes**
- ★ **2" x 2" cubes**
- ★ **Compression and modulus of rupture of brick**

"JOBSITER" is only one of a complete line of concrete testing machines. When better low priced testers are built—Forney's will build them.

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EQUIPMENT MATERIALS and METHODS

(continued)

Bar Screen Cleaning

BAR SCREENS, traveling water screens, etc., may be cleaned automatically with the differential head control system. The bar screen intermittent rake control eliminates the danger of excessive debris buildup and unsatisfactory service due to daily or seasonal variations in amount of water, wastes or sewage treated with resultant lower power cost and prolonged equipment life. Series HM units may be either indicating or recording and can be furnished with repeat signal assemblies for remote supervision. In addition, auxiliary control systems can be furnished for automatic rake spraying and conveyor belt actuation for removal of screenings to trucks, etc. **Devco Engineering Inc., CE-8, Caldwell Township, Caldwell, New Jersey.**

Flo-Eye Indicator

A NEW SIGHT-FLOW INDICATOR now lets you take a look inside your pipeline to determine if there is flow and the direction and condition of the fluid. Retaining most of the quality construction features of the company's high-pressure, high-temperature models, the new Flo-Eye Indicator has double sight glasses for clear observation of the fluid even under poor lighting conditions. It uses machined recesses and retaining rings for even seating of the sight glass gaskets to prevent leakage. The indicators can save their price many times over by preventing damage to expensive equipment, conserving power and avoiding shutdowns. **Schutte and Koerting Company, CE-8, Dept. M-V, Cornwells Heights, Bucks County, Pa.**

Automatic Aggregate Drying

TWO AUTOMATIC BURNERS for drying aggregate in an asphalt plant are operated by remote control from a station two floors away. This operation, including automatic ignition, final temperature control, all necessary safety controls and shut off, is at Bethlehem Steel Company's Blacktop Plant at Bethlehem Quarry. It was designed and built by Posey Iron Works, Inc. The burners used in the aggregate-drying process are low pressure oil burners specially designed for dryer operations. The burners are installed on a center outlet sand dryer. A CLO burner is used on the hot end of the plant, while a Model 784 is used on the feed or cold end. The burners heat large volumes of air, thereby drying and heating aggregate to the desired temperature as the aggregate curtain falls through the heated air in the rotary drum. **Hauck Mfg. Co., CE-8, 124-136 Tenth St., Brooklyn 15, New York.**

EQUIPMENT MATERIALS and METHODS

(continued)

Multi-Purpose Machine

THIS AUGER BACKFILLER is a multi-purpose machine with variable speeds and big capacity. It backfills at speeds from 0 to 2 mph. A hydrostatic transmission controlled by a single valve gives forward or reverse speed instantly. 3 point suspension makes mounting and unmounting of auger assembly fast and

Auger-Backfiller

easy, permitting change from one job requirement to another. Hydrostatic transmission transmits power to all four wheels, each of which is equipped with hydraulic brakes. The unit has power steering and compact unit construction. There is plenty of room for the operator and all operating controls are within easy reach. **Anchor Sales Corporation, CE-8, 1109 Shimp Drive, Celina, Ohio.**

Adhesive Bonds Masonry Material

AN INEXPENSIVE ADHESIVE described as a reinforced resin, incorporates a new plymer, Structoweld, to which it owes its bonding power. A two-part thixotropic compound, Adopox is capable of filling ½ to 1½ in. gaps between a granite, concrete or brick wall without sagging. In addition, its unusual balanced resiliency makes it compatible with a wide variety of material having different expansion rates. It is easy to apply in the field by trowel, and has a recommended working pot life of two hours. Within four hours, granite blocks cemented with the adhesive are held firmly in place. **Adhesive Products Corporation, CE-8, 1660 Boone Avenue, New York 60, New York.**

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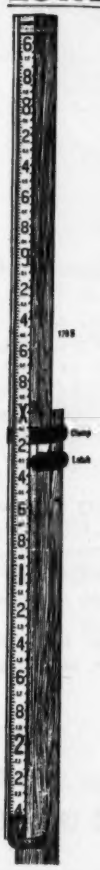

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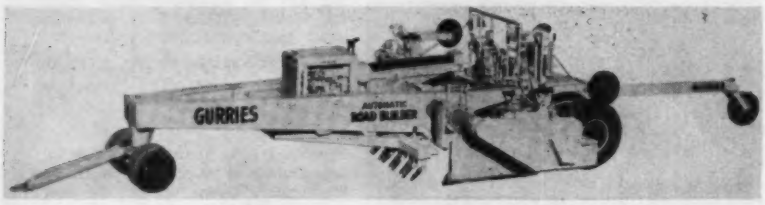

Automatic Road Builder

THE MODEL GARB-44 road builder is a high production, precision machine with the ability to automatically maintain blade height and cross slope in relation to a selected reference. The height of the blade can be controlled in four ways: wire follow, left side wheel follow, right side wheel follow and planing. During these operations the cross slope is automatically held to the desired setting by the pendulum control. Cross slope can be set for anywhere from 0 to 25 percent fall, left or right. The combined blade height and cross slope controls accurately to $\frac{1}{25}$ in. in 13 ft. The 20 in. diameter power screw casts excess material while grading, or balances bowl load for uniform strike off while spreading. **Gurries Manufacturing Co., CE-8, 1720 South First St., San Jose, California.**

Shut-Off Valve

AN ADDITION to the line of automatic shut-off valves, designated as IP-L/TEMP, provides two-way automatic safety by closing on either increasing pressure or ambient temperature, or both. This valve incorporates a diaphragm which senses line pressure and programs the valve into "CLOSE" position whenever the line pressure exceeds a pre-determined level. In addition, a fusible plug with a pre-determined temperature setting, is also activated whenever the ambient thermal point is reached. The valve is available in ASA pressure ratings from 150 to 2500 lb with higher pressures on request. **Security Valve Co., CE-8, 909 El Centro Avenue, South Pasadena, California.**

Crane Boom Stabilizer

THIS HYDRAULIC BOOM STABILIZER provides automatically controlled boom lowering, independent of ratchets, gears or clutches. It regulates at the onstart speed that is preferred and is overridden by brake application. In locked position the boom can be operated completely without hoist cables and will hold in any position. In the event of operator, draw works or boom hoist line failure, the stabilizer floats the boom slowly and safely to the ground, thus allowing sufficient time for personnel to clear the danger area. Damage to both property and boom is avoided. **Yaun Mfg. Co., Inc., CE-8, 2120 N. Third Street, P. O. Box 1508, Baton Rouge, La.**

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Write fully, give detailed description of work experience, include salary information.

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Literature Available

IT'S A MATTER OF RECORD—An 8-page booklet, D110, demonstrates how improvements in today's 235 hp D8H and the 140 hp D7D, result in greater profit potentials for owners. Details of features on the D7D touch on the turbocharger, dry-type air cleaner, power train, lifetime lubricated rollers and the exclusive oil clutch are included. **Advertising Division, Caterpillar Tractor Co., CE-8, Peoria, Illinois.**

UNIT AND BLAST HEATERS—A 4-section catalog, No. 956-R4-1-660, describing GRID Cast Iron steam heat transfer surface unit heaters (both horizontal and down blow), blast heaters and radiators with general treatment on corrosion in unit heaters, is now available. It describes and illustrates one-piece construction high-test cast iron heating sections, together with air distribution charts, heating capacities, conversion tables, etc. **D. J. Murray Mfg. Co., CE-8, Wausau, Wisconsin.**

DENSITY DETERMINATIONS—A brochure titled Moisture-Density Determinations for Civil Engineering Works, contains 12 pages describing nuclear soil moisture and density equipment. The VoluTESTer, as it is called, is an improved balloon density device for making density determinations in soil, sand cone apparatus and other related equipment. This discussion of nuclear methods is offered by **Testlab Corp., CE-8, 3398 N. Milwaukee Avenue, Chicago 41, Illinois.**

PORTABLE ENGINE-GENERATORS—A versatile series in sizes of 1000, 2000, 3000 and 4000 watts, A.C., 3600 rpm, provide dependable power source to operate all types of time-saving tools, lights and appliances. Features include dependable Briggs & Stratton engines, pull starter, protective carrying frame, rubber mounts and handy receptacles, with optional wheel dollys and housing also available. **Katolight Corporation, CE-8, Box 891, Mankato, Minnesota.**

WELDING MACHINES—A bulletin, 4609.1, describes performance features and construction details of the Idealarc R3M 3 phase rectifier type DC arc welder, which will handle any type of manual arc welding electrode. This model can be equipped for semi-automatic submerged arc welding. **Public Relations Depart., The Lincoln Electric Co., CE-8, Cleveland 7, Ohio.**

STEEL-PLY CATALOG—A 24-page catalog explains in detail the Steel-Ply system with case history uses of the forms and several products dealing with gang forming. Other products are the cantilever bracket, haunch bracket and extension angle as well as the regular line of safety shores, column clamps and ties. **Symons Clamp & Mfg. Company, CE-8, 4249 W. Diversey Avenue, Chicago 39, Illinois.**

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Literature Available

PLASTIC PIPE—A new edition of Commercial Standard 228-61, which includes plastic sewer pipe in 8, 10 and 12 in. diameters, has been published by the U. S. Department of Commerce. The new standard supersedes Commercial Standard 228-60. It provides a recognized specification for municipalities, engineers and architects in specifying plastic sewer pipe for mains, 8 in. in diameter and larger. **Superintendent of Documents, U. S. Government Printing Office, CE-8, Washington 25, D. C.**

STRUCTURAL BOOKLETS—A package of descriptive circulars on authoritative books for Civil Engineers is now available. Subjects covered include air conditioning, soils engineering, prestressed concrete, substructure analysis and design, structural design in metals, linear structural analysis, statically indeterminate structures, nondestructive testing, tensor analysis, and principles of engineering economy. **The Ronald Press Co., CE-8, 15 E. 26 St., New York, N. Y.**

PRESSURE MEASUREMENTS—A 4-page bulletin outlines the desirable features and the utility value of an instrument, Topazometer, which may be used with a high degree of accuracy as a low pressure deadweight gage or as a high range differential pressure manometer. It is claimed that the standard and dual scales may be read to 0.1 in. of water or 0.01 psi, with a full scale of 1000 in. of water or 36 psi. **ToPaz, Inc., CE-8, 2525 South Boulevard, Houston 6, Texas.**

CLAMPS, COUPLINGS AND JOINTS—Brochures covering clamps, couplings and joints provide detailed information on sizes and are illustrated with photographs and dimensional diagrams. They contain complete information on pipe joints which do not require threading or grooving, an improved hose clamp, band clamps, pipe repair clamps, identification clamps and threaded union joints for small diameter tubing. **Marman Div., Aeroquip Corp., CE-8, 11214 Exposition Boulevard, Los Angeles 64, California.**

FEDERAL SPECIFICATION—A 16-page technical bulletin, 100, covering Federal Specification INT. FS-SS-P-00385 has just been published. The specification covers cement mortar lined and reinforced cement mortar coated welded steel pressure pipe, from 4 to 42 in. in diameter, for use in water transmission, distribution, and feeder pipelines. The bulletin also contains Design Tables for water pressure classes 100, 150, 200, 250, 300, 350 and 400, as well as a Friction Loss Table for pipe diameters (waterways) from 4 to 48 in. and flows from 10 to 100,000 gpm. **Southern Pipe, Div. of U. S. Industries, Inc., CE-8, P. O. Box C, Azusa, California.**

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PERFORMANCE FIGURES—A bulletin describing the power increase in the new 125 rotary compressor is now available. The 53 hp engine provides a 60 percent surplus to the compressor at only 1600 rpm. Automatic switches to control air and engine oil temperature as well as design features to reduce maintenance and repair are described. Condensed specifications for the utility, skid and diesel units are also included. **Le Roi Division, Westinghouse Air Brake Company, CE-8, Sidney, Ohio.**

DRILLING RIG BULLETINS—Bulletins describing the line of blast hole drilling rigs from 2½ to 7⅞ in. hole size, will be mailed on request. The rigs operate through a mechanical drive and can be truck, crawler or wheel mounted. The LRD-3 is a top drive machine designed to drill 100 ft in depth. The LRD-2, a lighter rig, drills 30 ft in a single pass with direct drive through the rotary table. **Le Roi Division, Westinghouse Air Brake Co., CE-8, Sidney, Ohio.**

HANDBOOK FOR CONCRETE CONSTRUCTION—Celebrating their 50th year of progress in the development of products for concrete construction, Richmond Screw Anchor Co., Inc., has released a completely revised and expanded handbook of their more than 400 products. It consists of twelve separate bulletins, which include a cross index for products and types of construction. **Richmond Screw Anchor Co., Inc., CE-8, 816-838 Liberty Avenue, Brooklyn 8, New York.**

WATERPROOF PAPER—A 4-page brochure describes a weatherproof field book that permits permanent records to be made in rain and excessive humidity. Known as "Rite in the Rain," this paper is said never to warp, wrinkle or soak up moisture. It is said to be the only waterproof paper that can be written on while the surface is wet. The brochure is printed on this paper with ample space provided for testing. **Keuffel & Esser Co., CE-8, Third and Adams Streets, Hoboken, New Jersey.**

DRIER UNIT CATALOG—A 12-page catalog, AP-28, completely illustrates and describes Cedarapids Portable and Stationary Electric Motor or Combustion Engine Driven Drier Units with medium to large capacity range. Some of the benefits include open grid type lifting flights, high-lift discharge for either right or left side, patented smoke box seal, ring gear and pinion or saddle-chain drive, roller bearing trunnions, and efficient automatic burner control systems. **Iowa Manufacturing Co., CE-8, Cedar Rapids, Iowa.**

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Deep Depth SOUNDER

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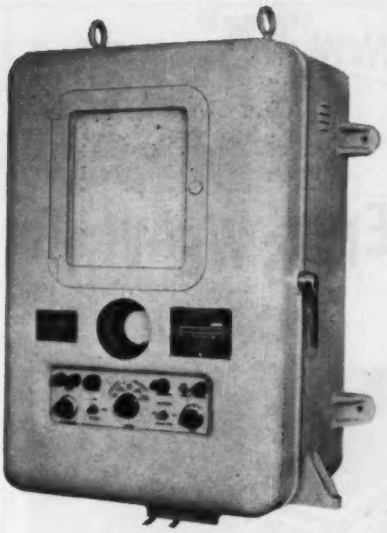

AN/UQN-1D. Edo Model 185 Deep Depth Sounder, developed originally for the U.S. Navy, is now in quantity use by the U.S. and other navies as well as commercially. Unit gives clear CRT indication of depth in two scales, 0-100 feet and 0-100 fathoms; records continuously in three scales, 0-600 feet, 0-600 fathoms, 0-6000 fathoms. No comparable sonar equipment has ever been manufactured in such large quantities and put to such universal use. For brochure, write Dept. V-3.

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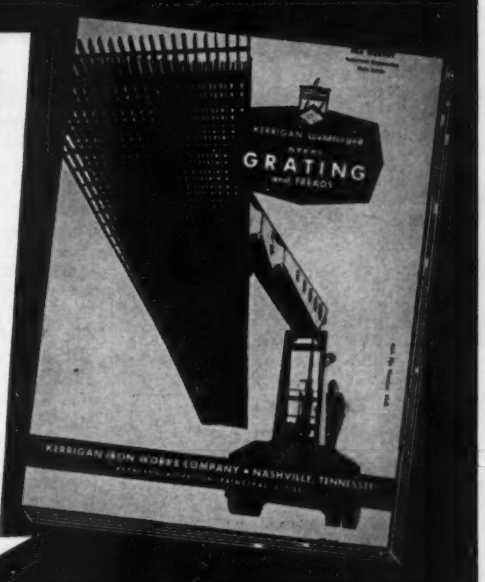

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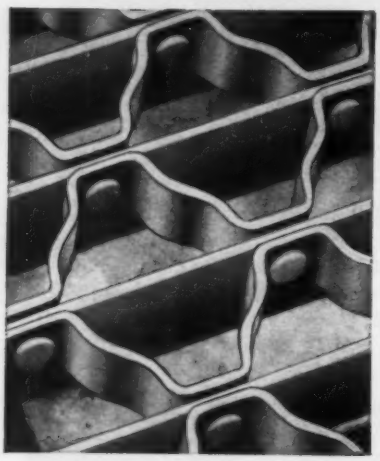

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Films Available

SOIL-CEMENT—A 16mm, sound and color film describes the standard ASTM-AASHO laboratory procedures for testing soil-cement and the latest short-cut testing procedures used with sandy soils. **Portland Cement Association, CE-8, 33 West Grand Avenue, Chicago 10, Illinois.**

SHOWCASE OF GLASS—Titled "Space Building for Man", this film reviews man's quest for space from pioneer days to the present. Tracing construction of the building from the steel skeleton to completion, the film emphasizes glazing of four glass walls and dramatizes how glass brings daylight indoors for the comfort and enjoyment of occupants. **Libbey-Owens-Ford Glass Co., CE-8, 811 Madison Avenue, Toledo 1, Ohio.**

THE MANUFACTURE OF CAST IRON PRESSURE PIPE—This motion picture shows the two centrifugal casting processes by which most cast iron pressure pipe is made—the metal mold and sand lined mold processes. **Cast Iron Pipe Research Association, CE-8, 3440 Prudential Plaza, Chicago 1, Ill.**

NEW DEVELOPMENTS IN PHOSPHATE ROCK FLOTATION—is the title of a full color motion picture. The 16mm film describes the operation of the newly-developed Hollingsworth-Sapp phosphate flotation process and makes comparisons between this process and a typical flotation system. **Wellman-Lord Engineering, Inc., CE-8, P. O. Box 2436, Lakeland, Florida.**

NIAGARA POWER PROJECT—A motion picture of one of the world's largest peacetime construction jobs, the Niagara Power Project, shows the $720 million project in detail, with emphasis on the giant penstock installation and excavation procedures in the conduit and other areas. **The B. F. Goodrich Company, CE-8, Akron, Ohio.**

THE REX THAT SUITS YOU BEST—This film highlights the design engineering and cost-reducing operational features of the Rex truck mixer lines. Star performers are Rex Model 77, the Wate-Saver for top legal payloads, and Model 155, a rugged mixer designed for minimum maintenance. **Chain Belt Company, Construction Machinery Section, CE-8, Milwaukee 1, Wisconsin.**

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From the MANUFACTURERS

NEW OFFICES: Vitro Laboratories is moving its missiles engineering staff into their new building in Washington . . . CompuDyne Corp. has opened a Los Angeles office . . . The Silicone Products Department of General Electric has moved its Detroit, Mich. office to Oak Park . . . Lock Joint Pipe Co. has opened a Research and Development Center in Wharton, New Jersey . . . **EXPANSION:** Consolidated Pipe Co. of America is constructing a plant in Stow, Ohio . . . Toch Brothers will expand their headquarters on Fifth Avenue besides opening a plant in Kearny, N. J. . . . The B. F. Goodrich Company will invest additional money in its expansion and modernization program of its Akron tire production facilities . . . Brown & Perkins, Inc., has formed a wire rope sling and assemblies manufacturing firm . . . Gar Wood Industries, Inc., has created a hydraulic division in Wayne, Michigan . . . **CONTRACTS:** Koppers Company, Inc. has received a contract from Ford Motor Co. to rebuild a battery of 61 coke ovens at its Rouge Plant near Detroit . . . Chemical Construction Corp. has been awarded a contract to design and erect the hydrogen synthesis section of a hydrogen plant being built by Linde Co., Div. of Union Carbide Corporation . . . A $3.1 million contract for modernization of 30 U. S. Army Sikorsky H-37A helicopters has been awarded to Sikorsky Aircraft by the U. S. Army Transportation Materiel Command at St. Louis, Mo. . . . **NEW NAME:** Western Reinforcing Steel Fabricators Association will be known as Western Concrete Reinforcing Steel Institute . . . Welsh Plywood Corp., a subsidiary of E. L. Bruce Co., has changed its corporate name to E. L. Bruce PlyWelsh Co. . . . Xerox Corporation is the new name of the Haloid Xerox Inc. . . . **ACQUISITIONS:** Lock Joint Pipe Company has announced the acquisition of Oscar Davis Company, Inc. . . . **APPOINTMENTS:** The Henry Pratt Company of Chicago, announces the appointment of Henry A. Porterfield as Field Sales Manager . . . Newark Ladder & Bracket Company has announced that they have become the exclusive distributor for Safety Tubular Prop Shoring Jacks . . . Northern Equipment Co. has been appointed distributor for Bucyrus-Erie Co. . . . Edward Kelly has been appointed district sales manager for the Side-O-Matic Unloader Corp. . . . A. C. Gossard was appointed Exec. Vice President for the Iowa Mfg. Co. . . . D. R. Miller has been appointed Vice President, Manufacturing of Trent Tube Company . . . Marketing of Weyerhaeuser Co. has announced the appointment of G. S. Reedal as sales manager for their western sales district . . . Texas Gas Transmission Corp. has elected V. W. Meythaler and F. K. Rader, Jr. to the posts of senior Vice President . . . William Ray Tanner has been appointed sales promotion and advertising manager of Clark Equipment International . . . William P. Balthrop has been appointed as president of Chrysler Corp's Airtemp Division . . . Jay F. Simpson has joined Alpha Portland Cement Co. as director of sales . . . Edward E. Brush has been elected Executive Vice President of Soiltest, Inc. . . . D. W. Roberts, Construction Products, Sheffield Div. of Armco Steel Corp., has been named president of the Wire Reinforcement Institute . . . Calvin Friar has been named manager, Outdoor Lighting Products Div. of The Union Metal Manufacfacturing Co. . . . Louis K. Lukity has been appointed to the post of Technical Superintendent of Hamilton Kent Mfg. Co. . . . Talford G. Smith, Jr., has been appointed traffic manager for Keasbey & Mattison Co's. asbestos-cement pipe manufacturing plant . . . A. H. Heim has been appointed manager of the Hydraulic Products Group of Fairbanks, Morse & Co. . . . Frank C. Messaros has been reappointed chairman of the Fluid Power Systems Section of the Philadelphia Section of ASME . . . George E. Hall has been appointed manager, sales development, construction machinery division, Allis-Chalmers Mfg. Co. . . . Stephen A. Fronek has been appointed Product Sales Manager of Silicon Steels for the Crucible Steel Co. of America . . . Simplex Valve and Meter Co., A div. of Pfaudler Permutit Inc., announced that Mr. Franklin L. Sommer has rejoined the Co. as District Sales Manager for the Philadelphia area . . . Robert G. Watson has been appointed sales manager of the Universal Atlas Cement Division of U. S. Steel.

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THE PAPERS presented at the ASCE Research Conference on Shear Strength of Cohesive Soils held at the University of Colorado, in June 1960, have been published in a single hardbound volume. The book contains the Foreword, Conference Program, Photographic Report, Opening Address, and all 26 Conference Papers. Also included are the written discussions and closures, and the reports by the moderators of panel sessions. The book has been prepared in an attractive cloth binding and is complete with a Table of Contents—Subject Index and Index of Authors and Discussers.

The list price for this volume is $10.00 per copy (net); no discounts are available.

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July

Journals: Power, Surveying and Mapping, Hydraulics, Sanitary Engineering.

2847. Studies for the Lower Monumental Power Plant, by Benjamin F. Smith. (PO) The study and analysis summarized herein demonstrate procedures used to optimize net power by balancing economic factors.

2848. Surveys for Spacecraft Tracking Sites, by Robert C. Wigand. (SU) Applications of surveying in spacecraft tracking are presented.

2849. Water Surface Profiles in Irregular Natural Streams, by Praxitelis A. Argyropoulos. (HY) A relatively simple and practical method is proposed for the computation of water surface profiles in natural streams or reservoirs.

2850. Power from the Sea, by El Sayed Mohamed Hassan. (PO) A plan to generate electricity economically from the loss of water in the Red Sea is presented.

2851. End Depth at a Drop in Trapezoidal Channels, by M. H. Diskin. (HY) The momentum equation is used to derive a general equation for the end depth in prismatic channels on mild slopes at an abrupt drop.

2852. Oroville Dam and Appurtenant Features, by W. G. Schulz, D. P. Thayer, and J. J. Doody. (PO) A study of the highest dam in the United States is presented.

2853. Highway and Bridge Surveys: Vertical Control and Special Control Problems in Bridge Construction, by Progress Report of the Committee on Engineering Surveying of the Surveying and Mapping Division. (SU) The need for precise vertical control as well as precise horizontal control when executing a major water crossing is outlined herein.

2854. Synthetic Unit Hydrographs for Small Watersheds, by Don M. Gray. (HY) A method is presented herein in which the unit graph for small watersheds can be synthesized from measurable topographic characteristics.

2855. Glen Canyon Powerplant, by Samuel Judd. (PO) The principal features of the Glen Canyon Powerplant in Arizona are described.

2856. Model and Prototype Research on Fish Ladders, by Berton M. Maclean. (PO) A resume of the many fishery and hydraulic model studies that were conducted on the Columbia River is presented.

2857. Private Power Development on an Entire River, by Richard S. Woodruff. (PO) The development of a complete river by one company for hydro-electric power production is described.

2858. Sanitary Consideration of Five-Mile Ocean Outfall, by Charles H. Lawrance. (SA) Engineering considerations that led to the establishment of the basic and detailed design of a submarine effluent outfall are studied.

2859. Surveying and Mapping Division, 1925-1960; Report of the Chairman, Executive Committee, by Arthur J. McNair. (SU) The history of the Surveying and Mapping Division of the American Society of Civil Engineers is outlined herein.

2860. Trickling Filtration Design and Performance, by W. Wesley Eckenfelder, Jr. (SA) An attempt to statistically correlate filter performance and develop generalized design formulations for domestic sewage treatment is analyzed herein.

2861. Cooling Pond Design in the Southwest, by T. J. Cotter and A. W. Lotz. (PO) Factors considered in the design of a cooling pond and their application are presented.

2862. Sanitary Engineering Education in a Changing World, by Daniel A. Okun. (SA) An analysis of the requirements for the education of sanitary engineers is presented.

2863. Manifold Stilling Basin, by Gene R. Fiala and Maurice L. Albertson. (HY) The manifold stilling basis used as a device for dissipating excess kinetic energy is studied.

2864. Drawdown Around a Partially Penetrating Well, by Mahdi S. Hantush. (HY) Equations of unsteady drawdown around a well partially screened in and steadily discharging from an artesian aquifer of uniform thickness and uniform hydraulic properties are developed.

2865. Continuous Parabolic Interpolation, by Willard M. Snyder. (HY) A method is presented by which interpolation on a continuously transforming parabola produces smooth curves through a set of data points.

2866. Use of Computers for Kansas River Flood Studies, by William L. Northrop and Clarence W. Timberman. (HY) A general digital computer program is described that produces flow hydrographs for an extensive network of basin subareas using unit hydrographs and routing coefficients.

2867. Some Legal Aspects of Sedimentation, by C. E. Busby. (HY) Legal aspects of sedimentation, important to the engineer, geologist, and soil scientist, are presented.

2868. Discussion of Proceedings Paper 2515, 2568, 2569, 2709, 2714. (PO) R. N. Bergstrom, J. R. Arena, and J. M. Kramer on 2515. G. S. Sarkaria and R. P. Wengler on 2568. G. S. Sarkaria and J. A. Veltrop on 2569. George Bugliarello on 2709. Charles Jaeger on 2714.

2869. Discussion of Proceedings Paper 2718. (SA) H. G. Aronson on 2718.

2870. Discussion of Proceedings Paper 2702. (SU) Shu-t'ien Li on 2702.

2871. Free Surface Flow in Homogeneous Porous Medium, by Roger J. M. DeWiest. (HY) The damping of the unsteady flow through a dam or levee with horizontal underdrain is analyzed.

2872. Discussion of Proceedings Paper 2362, 2369, 2374, 2438, 2452, 2652, 2653, 2706, 2713, 2776, 2780, 2763, 2260. (HY) W. M. Snyder on 2362. Emmett M. Laursen on 2369. Charles M. Moore on 2374. F. Wayne Townsend and F. A. Blust on 2438. W. M. Borland and Carl R. Miller on 2452. Phillip R. Smith on 2652. F. V. A. Engel, N. Rajaratnam, and Herman J. Koloseus on 2653. Harold G. Lorsch on 2706. M. B. McPherson on 2713. J. C. Stevens on 2776. H. C. Riggs on 2780. W. D. Baines and J. F. Keffer on 2763. Shoi-Yean Hwang on 2260.

2873. Measurement of Displacement and Deformation by Geodetic Methods, by F. Kolbold. (SU) Geodetic methods used for the measurement of terrain movements and deformations in structures are explained.

2874. A Survey of Sanitary Landfill Practices, by the Thirtieth Progress Report of the Committee on Sanitary Engineering Research. (SA) Technical data on sanitary engineering practices are presented.

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Index to Advertisers

Acker Drill Co., Inc. 100
Alaska, State of 107
Allis-Chalmers 13
The Alpha Portland Cement Company 79
American Bitumuls & Asphalt Company 10
American-Marietta Company 12
American Steel & Wire Division of United States Steel Corporation ..... 76 and 77
Armour Research Foundation 107
Associated Pipe and Fitting Company, Inc. 113
Automatic Nut Company 116

Bendix Computer Division, The Bendix Corporation 30
Bethlehem Steel Company ..... 1, 81, 82, 83, 84, 90 and 91
Borden Metal Products Co. 2
Brown & Brown, Inc. 110

Cast Iron Pipe Research Association ..... 14 and 15
Centriline Corporation 18
Chicago Bridge & Iron Company 21
Concrete Reinforcing Steel Institute 110

The Eagle-Picher Company 8
Edo Corporation 117

Forney's Inc., Tester Division 111

Gregory Industries, Inc., Nelson Stud Welding Division .. 19
Gulf-Seal Corporation 119

Rodney Hunt Machine Co. 16

Inland Steel Company ..... 22 and 23
International Business Machines Corp. 95
Irving Subway Grating Co., Inc. 118

Johnson Gear & Manufacturing Co., Ltd. 110

Keasbey & Mattison Company ..... 93 and 94
Kern Instruments Inc. 102
Kerrigan Iron Works, Inc. 117
Koh-I-Noor Incorporated 102

Laclede Steel Co. 28
Lehigh Portland Cement Company 97
Lenker Manufacturing Company 113
Lock Joint Pipe Co. ..... 4th Cover
Lone Star Cement Corporation 32

M & H Valve and Fittings Company 98
Macomber Incorporated 11
Moretrench Corporation ..... 2nd Cover

Newport News Shipbuilding and Dry Dock Company 73

Phoenix Bridge Company 118
Pittsburgh-Des Moines Steel Co. 17
Portland Cement Association 9
Posey Iron Works, Inc. 118
Prestressed Concrete Institute ..... 24 and 25

Richmond Screw Anchor Company, Inc. 104
John A. Roebling's Sons Division The Colorado Fuel and Iron Corporation 85

Sika Chemical Corporation ..... 3rd Cover
Sonoco Products Company 20
Spencer, White & Prentis, Inc. 109
Sprague & Henwood, Inc. 100
Symons Clamp & Mfg. Co. 26

E. A. Thompson Company, Inc. 111
Tretol Inc. 116

U. S. Pipe and Foundry Company ..... 6 and 7
United States Steel Corporation ..... 4, 5, 76 and 77
United Steel Fabricators, Inc. 105
Universal Form Clamp Co. 104

Vibroflotation Foundation Co. 99

Warren-Knight Company 114
Charles R. Watts Co. 113
C. H. Wheeler Mfg. Co. 101
Wild Heerbrugg Instruments, Inc. 27
R. D. Wood Company 75

Professional Services ..... 122, 123, 124 and 125

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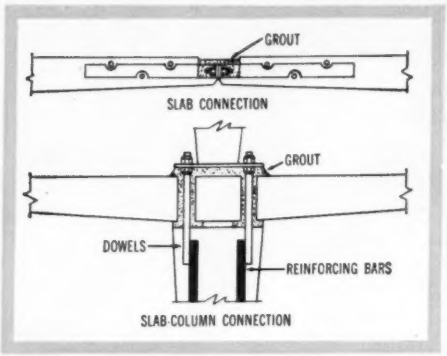

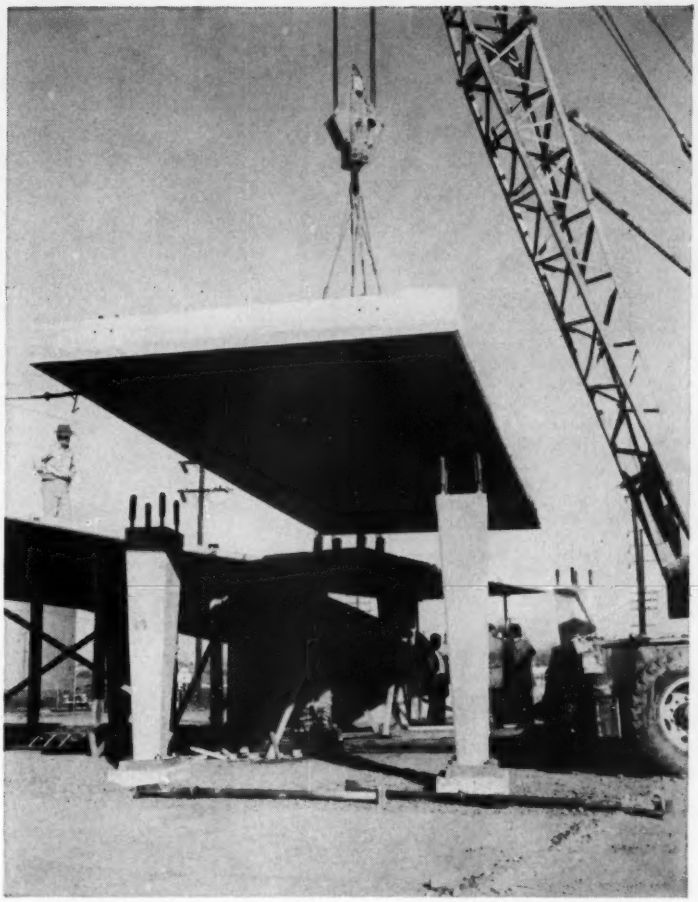

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